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FILAMENT MATERIALS.

The choice of a material for the filaments of incandescent lamps depends mainly upon two properties, the melting point and the vapor tension at temperatures below the melting point. In addition to these physical properties the cost of material, facility of working and the adequacy of the supply must also be considered. Metal filaments were tried in the early days of the art, but platinum, the only metal of high melting point which may be said to have been really available at that time, proved inferior to carbon. The latter has the highest melting point of any known substance and on this score is the most suitable material known. With respect to its vapor tension, however, carbon is deficient, since at temperatures close to its melting point (or more properly, at the working pressure, the point of sublimation) carbon vaporizes with too great rapidity, with the result that the bulb of an incandescent lamp is rapidly blackened. It was found necessary, in consequence, with the early carbon lamp, to operate at a temperature of about 1,800 degrees centigrade, although with the later forms of carbon filament, such as the metallized filament, it has been possible to materially increase the working temperature without unduly shortening the life.

The three metals which have the highest melting points and which are now commercially available, have all been tried as filaments for incandescent lamps. The melting point of osmium is about 2,700 degrees centigrade, but as this metal is comparatively scarce, little commercial use has been made of it. The melting point of tantalum is variously given as from 2,800 to 2,900 degrees. A recent measurement by Pirani and Meyer, noted elsewhere in this issue, gives a value of 2,850 degrees. Tungsten, however, has a still higher melting point, which, according to Waidner and Burgess, is about 2,950 degrees, whereas Langmuir in a recent paper concluded from candlepower measurements that it must be over 3,100 degrees. While all of these metals have melting points lower than carbon, their vapor pressures are so much less that they can be operated at higher temperatures, and consequently at higher efficiencies. While selective radiation accounts in a small part for the higher efficiency of the metal lamps, the advantage is mainly due to the fact that they are operated at a higher temperature. Tungsten lamps are now upon the European

market, which have a specific consumption not exceeding one watt per horizontal candle, combined with long life.

The relations between operating voltage and candlepower, and between wattage and candlepower, are very important, and investigations of these relations have been made by many observers. The values given for the exponent of voltage, in proportion to which the candlepower varies, are very discordant. The problem of determining reliable values for these relations has been undertaken by Mr. F. E. Cady, working in the physical laboratory of the National Electric Lamp Association. Upon other pages of this issue will be found the results of Mr. Cady's work. These determinations have been carried out under conditions which permitted accurate work and, moreover, proper consideration has been given to the precautions which should be exercised in an investigation of this kind. Mr. Cady's results consequently not only thoroughly cover the field involved, but the results may be depended upon as being the most accurate and reliable which have yet been presented.

THEATER ILLUMINATION.

An important service to the art of illuminating engineering has been performed by Messrs. Vaughn and Cook, of Milwaukee, in calling attention to the great number of still unsolved problems in theater illumination. Their paper on this subject presented last week before the Illuminating Engineering Society, a brief abstract of which is given in another part of this issue, is distinctive, moreover, in being one of the first broad treatments of the numerous phases of the subject. But little has been published on theater illumination, aside from occasional meager descriptions of installations, and almost nothing at all on the technique of the lighting of the stage.

As almost all theatrical performances are given under artificial light, it is surprising that so little recorded knowledge on the subject has been available. There are several reasons for this, however. One is the jealous reluctance of theater managers to giving out the facts on how their lighting effects are produced. Another is that stage lighting in particular has been left largely to the operating electricians, who have carefully guarded many of their secrets; although mostly ignorant of the scientific principles of illuminating engineering, they have on the whole produced very skillful effects even by rule-of-thumb methods.

In the lighting of the auditorium, on the contrary, relatively little skill of high order has been displayed in a great many cases. The ignorance of some of the most fundamental requirements of theater illumination shown by some designers may partially be excused by the dearth of literature on the subject. In many instances, however, the design has been left to men who not only had no real conception of the principles of good illumination, but openly expressed contempt for what has become known as illuminating engineering. It might be inferred from this that the designs produced by such men would be highly artistic, even though devoid of harmony with many scientific requirements.

That such has not been the case is only too sadly apparent when one observes frequent instances of fixtures harshly contrasting with the architectural and decorative treatment of the interior, lacking in proper proportions, or producing such inadequate and poorly distributed illumination that it had to be supplemented by other equipment that shows at a glance that it was not contemplated in the original design. Fixtures that in themselves are beautiful are often placed where but few can see and admire them, whereas in conspicuous locations incongruous equipment is exposed to view. The placing of bright lights in the field of vision of a large part of the audience has been exceptionally common and has proven particularly aggravating when the house is suddenly illuminated at the close of a scene or act. Such defects are found not only in the smaller and cheaper theaters, where their presence might almost be pardoned, but even in some of the largest and most modern metropolitan theaters.

On the exterior as well has there been lack of study toward the production of effects that are not only novel and attracting, but that might readily be made truly attractive. The possibilities of facade lighting so as to bring out the most striking architectural features have scarcely been considered. Considerable money is usually spent in making the architectural design pleasing and at the same time original. By skillfully arranged lighting it can be made as pleasing by night as by day and even attractively original effects may be produced.

The remedies for many of these conditions, both internal and external, are pointed out in the paper by Messrs. Vaughn and Cook, which has been referred to. They show, for instance, the value of indirect lighting of the auditorium. As far as the audience is concerned, the lighting of the stage is accomplished without any visible lamps. Until the last few years, however, the indirect system has not been employed in front of the curtain, where it has many advantages. Semi-indirect lighting has not yet had any fair trials, though it would seem to possess some highly desirable features if applied in a masterly way.

Without going into many of the admirable points brought out in the paper, a general conclusion may readily be drawn from it. This is that the design of theater lighting, on account of its many-sided character, must be entrusted to those men who can produce an illumination fully in accord with the principles and requirements of illuminating engineering, of the architectural and decorative arts, of the histrionic purposes of the building, and of the comfort and pleasure of the audience. Fortunately, there are already some broad-minded men that can qualify for such an exacting rôle.

SELLING ELECTRIC POWER THROUGH BOOKLETS.

Every agency must be pressed into service in these days in order to popularize a new commodity to the fullest extent, and electric power is no exception to this requirement. It goes without saying that nothing can take the place of the trained solicitor in the extension of electrical applications, but within the past year or so it has been found extremely helpful to supplement the work of the sales engineer in the field of motor driving with carefully prepared booklets illustrating the benefits of electricity in specific industries, the solution of problems of power demand and motor speed, and the tabulation of important constants and formulas associated with a given line of industrial operations. Such booklets have not as yet come into the extended use which their convenience and business-getting powers warrant, and probably this is because many organizations do not realize the character of information which should be printed and the appeal which a piece of work of this type makes to the mind of the layman, provided it is filled with technical data of real value set forth in clear and simple language.

It is doubtless out of the question to prepare booklets in any single central-station field covering in separate publications the uses of electric power in all the industrial applications of the territory, and good judgment must be displayed in the selection of industries thus to be treated. The best plan appears to be to prepare a booklet dealing with power problems in the most profitable industry from the standpoint of electrification, and then adding other similar publications as conditions permit. In a given territory, for example, refrigeration may offer the largest opportunity for profitable power sales; in another field, electric pumping may offer the company the best return; and in a third, the driving of shoe factories or textile mills may present the most attraction. Whatever may be the field of application, it follows that the same general line of attack can be made upon the conservatism of the prospective power consumer, and in some cases practically the same language can be turned to account that has proved convincing in the extension of the motor drive in other situations. Thus, the question of depreciation of steam and gasoline engines may be somewhat affected by the particular branch of industry which the central-station company is seeking to electrify, but all the general factors of the problem are independent of the specific application, simply because the intrinsic character of the equipment to be displaced by electric motors remains the same throughout a great range of utilization.

Under a carefully arranged plan of typography, with due regard to paragraph headings, a representative power-selling booklet may well take up at the outset the advantages of electricity which are most striking in comparison with the often unsuspected defects of competitive motive powers. The question of original cost is worth emphasizing, since motors are in numerous cases far cheaper than gas engines and steam engines, especially when taking the producer and boiler investment into account. Without attempting to more than outline some of these points, mention may be made of the superior durability of electric motors, the low cost of their repairs and nominal attendance required for their operation. In a typical booklet dealing with an industry in which acute competition with gasoline engines was a serious problem to the central station, it was shown that in the territory under consideration the average life of a gasoline engine was only seven years; that cylinders needed reboring every three years if used to any extent; and that crystallization was much more severe on account of the reciprocating motions involved. The greater difficulties of lubrication, dangers of vibration, variations in the price of fuel, troubles arising from evaporation and leakage, damage to the product while shut-downs are tying up the work, and frequent incompetence of employees in handling delicate machinery were all emphasized. A special point was made of the fact that the durability of alternating-current motors has not yet been ascertained, since many of the first ones installed in the district are still in operation. The absence of any jar in operation was shown to be beneficial to the life of the machinery driven, and particular mention was made of the presence of only two bearings, perfectly housed and lubricated by large oil wells and brass rings. The absence of any necessary adjustments, cheapness of new bearings, use of power only when carrying a load, and in proportion to the latter, were all reviewed. There is scarcely any limit to these fundamental advantages of electricity, which may be set forth in cogent phrasing in the front of a power booklet.

Local conditions will obviously dictate the character of matter to be placed in the body of a power-soliciting pamphlet, but in general it has been found desirable to include pithy descriptions with photographic reproductions of typical installations, giving testimonials when available from persons in the line of industry which is being electrified. Such information as how to read electric meters, calculation of horsepower, methods of measuring output and flow of water, existing connected loads in the industrial branch covered, simplicity and flexibility of motor applications may be emphasized to advantage. In cases where booklets have been successfully used in this way, they are designed to supplement the personal work of the solicitor in the field, crystallizing the points of his arguments on behalf of electric service and giving the prospective power consumer a valuable compilation of data relating to his particular industry to be looked over at his leisure. There is no question that many future campaigns for the installation of electric power in specific industries will be fought along these lines, once current-selling organizations appreciate the great benefits of convenient collections of data and arguments bearing upon individual manufacturing fields. With proper preparation of this kind the campaign will usually be successful.

Vehicle Club Organizes.

The Electric Vehicle Club, of Boston, has formed a permanent organization by the election of officers. By unanimous vote Day Baker, the New England manager of the General Vehicle Company, was elected president, and Leavitt L. Edgar, son of Charles L. Edgar, president of the Boston Edison Company, was elected secretary. This organization, which has been in existence for some time, is now placed on a good permanent basis and has a large number of members. In the near future the first annual dinner of the club will be held, to which many prominent speakers from all over the country have been invited.

International Wireless Conference in London.

The Bureau International de l'Union Telegraphique has announced that the next Radio-telegraphic Conference will meet in London on June 4, 1912, and that the latest date for the submission of proposals to the Conference is postponed until December 1 next.

British Electrical Manufacturers Reorganize.

The electrical manufacturers of the United Kingdom have formed the British Electrical and Allied Manufacturers' Association, Incorporated, as the successor to the National Electrical Manufacturers' Association.

Professorship for Small Currents.

In the technical school at Charlottenburg, Germany, a professorial chair in "Schwachstromtechnik," or small-current practice, has been established. Rudolf Franke, who is a director in the Mix and Genest Company, will be the first professor to occupy this position.

Washington Section Meeting.

At the meeting of the Washington Section, American Institute of Electrical Engineers, on November 14, an address on "The Navy's Coast Signal Service" was delivered by D. W. Todd, Lieutenant-Commander, United States Navy.

Monument to Schuckert.

A monument has been erected in Nuremberg, Germany, in memory of Sigmund Schuckert. Exercises in connection with the unveiling took place on October 18.

Wireless Message Flashed from Italy to America.

On November 19 the first wireless message from Italy to America was sent by G. Marconi to John Bottomley, of New York, vice-president of the American company. This message came direct from the long-distance station at Coltano, Italy, to Glace Bay, Nova Scotia, and marks another epoch in wireless telegraphy.

The station at Coltano was erected under the auspices and at the request of the Italian Government, which has at all times taken the greatest interest in Marconi's work, and the primary object of the erection of this station was to bring more closely into connection Italy and South America, through a station now building near Buenos Ayres; also to bring Italy generally into more immediate touch with the world.

This station at Coltano is one of the most, if not the most powerful wireless station in the world, has received Marconi's personal attention and supervision during its erection, and will serve as a model for the station in contemplation in the United States which will connect, by wireless, America with the United Kingdom, Italy and France, so soon as the latter has its long-distance station perfected.

Rate Research Committee Meets.

The Rate Research Committee of 1911 of the National Electric Light Association held its first meeting on November 10 at the office of S. E. Doane, in Cleveland, O. Those present included E. W. Lloyd, chairman; L. H. Conklin, S. E. Doane, R. S. Hale, H. R. Lyons and R. B. Norton. After spending the day in discussing its work and plans, the committee adjourned to meet again in New York City on December 8.

The Report of the Research Committee of 1910 is now available in the published volumes of the *Proceedings*, and is worthy of serious study.

Los Angeles Section A. I. E. E. Met November 21.

The regular monthly meeting of the Los Angeles Section of the American Institute of Electrical Engineers was held on November 21. Professor Harris J. Ryan, Leland Stanford University, presented a paper, "Polarity in Polyphase Current Circuits." Professor W. A. Hillebrand, Oregon Agricultural College, presented a discussion of the paper under the title, "Some Fundamental Considerations in the Application of a System of Graphics to Alternating Current Circuits."

The Initiative and Referendum.

At the regular meeting of the Electric Club, Chicago, on November 22, Walter Clyde Jones, state senator of Illinois, spoke on "The Initiative and Referendum." The speaker referred to the two powers exercised by the state legislature which were responsible for corruption of the two types represented by the Lorimer scandal and the "jack-pot." These are the election of United States senators and the passage and enactment of unsupervised legislation.

The referendum has been in effect in Illinois since the Constitution of 1870 was adopted, in respect to banking laws. No such law becomes effective until submitted to the electorate. The same is true of bond issues and constitutional amendments. It should be made applicable to all legislation in order to do away with the corrupt passing of undesirable laws and the blackmail which is exercised through the threat of passing legislation inimical to particular interests. Similarly the initiative enables the people to pass laws which the legislature may be bribed to suppress. The result in those states which have already adopted these measures has been to make the legislators responsive to the wishes of the people, so that it is seldom necessary to exercise direct legislative powers.

W. M. Connelly, M. G. Lloyd, W. R. Bonham and W. D. Ray joined in the discussion.

Guayule Rubber Production.

The report of the Mexican Government just issued shows that during the last fiscal year there was exported from Mexico refined and crude guayule rubber to the value of $32,985,679.

Practically all of the guayule rubber produced in Mexico is exported to the United States where it enters largely into the manufacture of automobile tires and electrical appliances.

1912 Heating Convention.

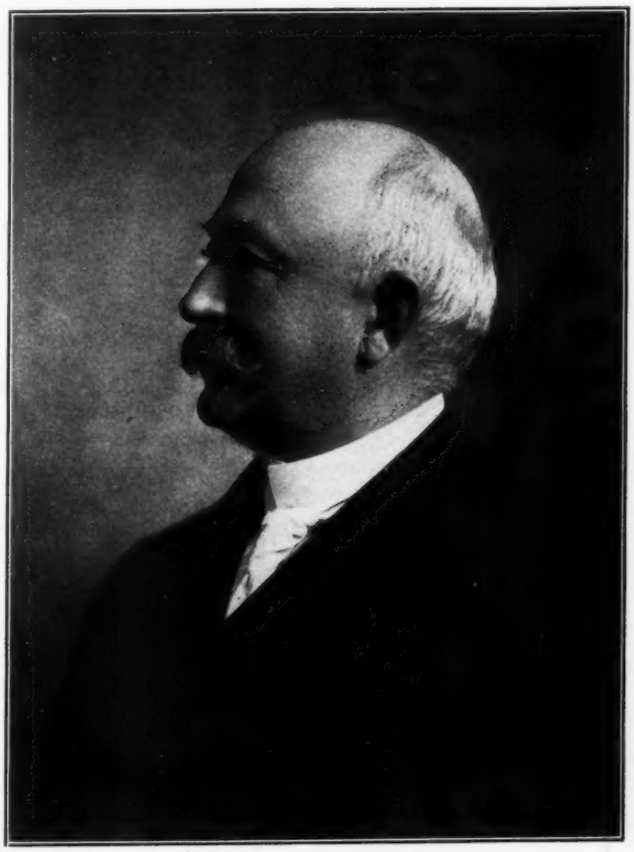
The fourth annual convention of the National District Heating Association will be held in Detroit, Mich., June 25, 26 and 27, 1912.

Willard L. Candee.

The story of the struggles of the pioneers in the introduction of the telephone has been told over and over again, but despite this repetition there is always available an anecdote or incident which serves to heighten the romantic interest which attaches to the birth of this great industry. The success which has come to many of the heroes of the telephone is also suggestive of the reward which generally follows the persistence and courage with which they overcame what at that time seemed to be almost insuperable difficulties.

One of the first men in this country to see in the telephone the prospect of a great future, was Willard Lyman Candee. In 1873 he was a telegraph operator and thus keenly interested in any development in the electrical field. When the story of Bell's invention, and the result of the successful exhibition given in Salem in 1877, became known he immediately took up the telephone as a practicable commercial enterprise.

Charles A. Cheever and Hilbourne L. Roosevelt organized the New York Telephone Company in August, 1877, and Mr. Candee became associated with them as their expert, construction man and salesman. Getting telephone contracts in those days was a mighty difficult proposition, but Mr. Candee got contracts and a good many of them, but for a long time it was hard up-hill work and not only was it necessary to exercise the consummate skill of the salesman to convince the recalcitrant subscriber, but Mr. Candee had also to make of himself a showman of superior ability, creating all kinds of diversions and opportunities for bringing out the possibilities of the telephone in some spectacular way. One of the first applications of the telephone under Mr. Candee's direction was in connection with the old rifle range of the National Guard of the State of New York at Creedmoor, L. I., during the international rifle match between Great Britain and America, at which the Americans won. Here the young enthusiast had built a line from the marksman's position to the target pit. As each shot was made the target men would announce the result to Mr. Candee and this expedient was probably one of the most successful advertising ideas that had at that time been carried out in favor of the telephone. In August, 1877, there were five telephones in practical working order. One of the most efficient lines was strung from Mr. Candee's boarding house on Gates Avenue to his father's house on Quincy Street in Brooklyn. The idea of a central and a network of connected wires had not entered anyone's head. All the lines except one ran from the company's office in the Tribune Building, in New York City, one up to 704 Broadway, the second to a telegraph office at 140 Fulton Street, the third to the office of E. N. Dickerson in a nearby building, and a fourth to the shop of a maker of telegraph supplies in Broad Street. The fifth ran from the office of a wire manufacturer in John Street, New York, to the plant in South Brooklyn, an incredible distance of five miles. This was the first paid telephone line in New York, and the first subscriber was a wire manufacturer, who was then making the wire for the cables in the original Brooklyn Bridge, and the idea was suggested of his utilizing the new device. This installation was of great advertising value to the early company.



WILLARD L. CANDEE,
President of the Okonite Company.

In 1879, Mr. Candee became associated with the Weston Electric Light Company, and in 1881 he took an active part in organizing and developing the Jablochkoff Electric Lighting Company with headquarters on Sixth Avenue in New York City. On March 26, 1884, he became associated with Chas. A. Cheever in the new insulated-wire manufacturing company under the firm name of the Okonite Company. Mr. Candee has been associated with this organization as an active official ever since and is now president of the company.

The word "Okonite" had an interesting origin. In response to a recent inquiry Mr. Candee explained it as follows: "The word was coined from the telegrapher's 'O. K.,' meaning 'all right,' and the last syllable (nite) of 'vulcanite.' The letter 'O' was inserted as an expression of delight, and to make it readable."

Mr. Candee is one of the most public-spirited, openhearted, conscientious and thoroughly democratic magnates one could meet. He has always taken a great interest in civic affairs, and for a long time has been intimately associated with the National Guard of the State of New York. As captain of Company B, of the 23rd Regiment, he was famous for having the best drilled company in the state, and he and other sharpshooters of his company have carried off the highest honors in target practice.

As a business man, Captain Candee commands the respect of the entire electrical industry, and the things that he and his associates have always stood for are reflected in the product of the great house they represent, a product which, it is conceded, establishes the standard the world over for material of its kind.

Theater Lighting Discussed By Chicago Section, Illuminating Engineering Society.

A meeting of the Chicago Section of the Illuminating Engineering Society was held at the Great Northern Hotel, Chicago, in connection with luncheon on November 16. A paper by F. A. Vaughn and G. H. Cook, of Milwaukee, Wis., entitled, "Theater Illumination," was read by Mr. Vaughn. A large number of photographs, drawings and lantern slides were used in illustrating the paper, a condensed summary of which follows.

THEATER ILLUMINATION.

The proper illumination of theaters requires a correlation of all the sciences and arts on which illuminating engineering is based. The requirements of such illumination are many, among which are: that the audience must be relieved of any disturbing influences interfering with its enjoyment; the lighting must be agreeable to the various tastes of all classes of auditors; it must harmonize with the ideas of the actors and please them both in the dressing rooms and on the stage; externally it must attract passers-by; internally it must remove the sham and help produce realism; glare (with its accompanying eye-strain, drowsiness and headache) must be avoided; consideration must be given to bringing out the architectural beauties of the theater, the beauties of costumes, complexions, etc.; finally, economy must not be lost sight of.

A careful outline analysis of theater lighting prepared by the authors shows the breadth of its scope. The exterior lighting is treated in a variety of ways from ordinary street lamps, as used with foreign theaters, to the spectacular and even grotesque lighting so common in this country. Much of the latter is obnoxiously glaring. Signs, both inert and animated, are used to attract the attention of the wanderer on the street. Outline lighting with studded lamps is frequently used. More attractive effects are obtainable by illuminating the entire exterior, or at least its most conspicuous features, by means of projectors or concealed lamps. Outside utility lights are needed in the illumination of the portico, entrances, cab calls, etc.

The interior presents more problems. Most commonly the auditorium has been lighted by means of a central chandelier, aided by brackets along the front edge of the balconies and studded lamps on the arches or dome. In all such direct lighting schemes the effect of the resulting glare has been lost sight of. The authors point this out in a number of cases. They then describe the remodeling of the Pabst Theater, in Milwaukee, in which the auditorium is exclusively illuminated by means of indirect fixtures. A large indirect dome unit forms the central feature; it was ingeniously designed to throw most of its light asymmetrically toward the front of the ceiling and less toward the rear above the gallery; a screen in the center of the bowl shields the larger and more powerful front lamps from the spectators in the upper seats of the gallery. Indirect-lighting equipment was also used in the entrances, foyer and box office with excellent results. A theater is now being planned in which semi-indirect lighting will be used exclusively. Emergency lighting is an important matter to receive attention; exit and panic lights must be provided and should always be controlled from the box office. Stairway and fire-escape lights come in the same category. In many cities some lamps must be kept lighted during moving-picture exhibitions.

On the stage the variety of illumination that must be provided is great. It is all controlled from the electrician's switchboard. Since the use of tungsten lamps, dimmers have had to be largely redesigned. There is usually a lack of uniformity of illumination at the front and rear of the stage. This can be remedied by closer attention to the design of reflectors, troughs, etc. Spot lights produce a very aggravating glare to the actor. Attention should be given to the different effects produced on an actor's "make-up" by carbon lamps in the dressing room and tungstens on the stage. Many improvements in the lighting of dressing rooms, and particularly of their mirrors, are sorely needed. The authors have invented an adjustable mirror combined with an abundant illumination thereof that is free from glare.

The paper was copiously illustrated throughout with examples of both foreign and American theaters. Data and curves on many illuminometer tests were also given.

The discussion of the paper was opened by J. R. Cravath, who declared that the investigations of the authors had shown no difference in the relative effectiveness of direct and indirect lighting for the public portions of a theater. Each may be used satisfactorily if intelligently applied. A hopeful feature of the times is that the importance of avoiding glare is being recognized. Glare has two deleterious effects: (1) it prevents us from seeing clearly, which is an effect similar to halation on photographs, (2) it draws our attention involuntarily to brilliant light sources and therefore, in the case of a theater, lecture hall or church, causes distraction.

A. J. Sweet said that in his opinion the effects of glare may be analyzed somewhat differently from Mr. Cravath's classification. Firstly, there is a marked depression of the visual functions, which depends on the angle of the impinging rays; secondly, there is produced more or less discomfort, depending on the intrinsic brilliancy of the light source. He felt that as regards the latter indirect theater illumination is certainly the most comfortable, although some installations of this nature might produce depression of the visual functions. One admirable feature of indirect lighting for theaters is that it eliminates sharp shadows and, if intelligently applied, produces the highly desirable effect through its soft illumination of making the human features more attractive than most direct systems. Mr. Sweet also commended the authors of the paper for being practically the first to call the attention of illuminating engineers to the broad scope of theater illumination. Little literature on the subject is available and scarcely any on stage lighting.

O. J. Bushnell asked whether the semi-indirect system seemed preferable to the pure indirect illumination. Mr. Vaughn said he had not yet formed a definite opinion; the installation he had referred to had not progressed far enough to base any reliable predictions upon this point, although the semi-indirect system would doubtless be found to possess several desirable features.

In reply to a question by T. H. Aldrich as to whether the indirect lighting of the Pabst Theater had really been found to be equally effective and at the same time less fatiguing than the original direct lighting, Mr. Vaughn said that there was no question about its effectiveness, but no experimental tests of relative fatigue had been made. However, everyone that has seen the new lighting has seemingly been pleased with it. No one apparently has found any fatigue resulting from it. The original installation, on the contrary, produced a great deal of eye-strain and fatigue.

Mr. Cameron stated that with the semi-indirect system less of the total flux is thrown on the ceiling than with a pure indirect system, consequently the relative absorption of the ceiling is much higher than with the latter and a less efficient unit results, since the amount of direct light passing through the art-glass dome is very small.

Mr. Cravath suggested that the second feature of Mr. Sweet's classification of the effects of glare should be modified, because it is the relative intrinsic brilliancy of the light source compared with that of the surroundings that produced glare.

Mr. Vaughn briefly closed the discussion by stating that the paper had intentionally been made to cover hastily a wide range of aspects of theater illumination so as to point out the large number and variety of problems involved. It was to be hoped that interest in the subject would be aroused and detailed attention given to its various branches.

At the next meeting of the Chicago Section the subject for discussion will probably be school lighting.

Lighting as an Art.

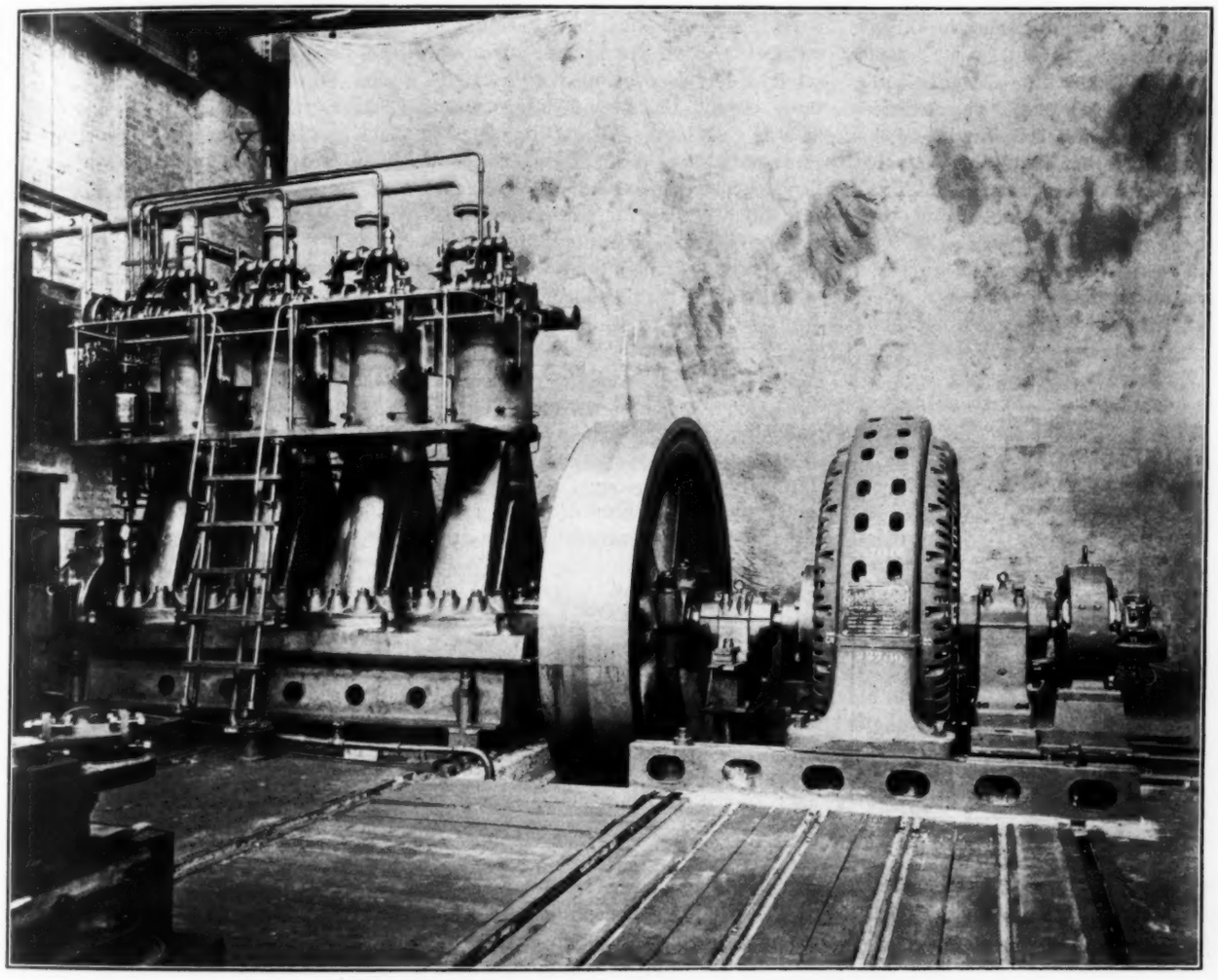
At the meeting of the New York Companies Section of the National Electric Light Association on November 20, E. L. Elliott spoke on the subject "Lighting as an Art."

Diesel Plant for the Argentine.

The accompanying photograph shows one of two Willans-Diesel oil engines of the four-cycle four-crank type, that have been built to the order of the Alianza Company, Limited, of London, for lighting and power purposes at its nitrate works at Bellavista in the Argentine Republic. The alternating-current generator to which each engine is coupled direct has been built by Siemens Brothers Dynamo Works Limited. The standard normal output of each engine is 335 horsepower when running at a speed of 220 revolutions per minute, with an overload capacity of ten per cent for periods not exceeding two hours. Each alternator with its direct-coupled exciter is of three-phase type, generating current at a voltage of 220 and twenty-five cycles. Each generator has a rated normal full-load capacity of 140 kilowatts on a power factor of 0.8. Both the combined sets are arranged to operate in parallel.

The following are the guaranteed fuel-consumption figures in pounds per brake horsepower per hour, and were subject to a margin of five per cent to allow for the newness of the engine:

Fifteen per cent overload, 0.44.
Full load, 0.44.
Three-fourths load, 0.46.
One-half load, 0.52.
One-fourth load, 0.72.



WILLANS-DIESEL ENGINE WITH SIEMENS GENERATOR.

The principal dimensions of the set are as follows:

Total overall length, 28 feet 9 inches.
Total overall width, 11 feet 6 inches.
Total approximate height, 11 feet 2 inches.

Approximate net weight, 57 tons.

These two sets are identical with two sets recently shipped to South America, the engines also being built by Willans & Robinson Limited, and the alternators by Siemens Brothers Dynamo Works Limited.

Undeveloped Power in Eastern Rivers.

The rivers of the northeastern and middle eastern portions of the United States are the best known in the country and the earliest in point of development, and their usefulness as sources of power and centers of industry has been demonstrated for several generations. Nevertheless it has been shown by the work of the United States Geological Survey during past years, and it is again demonstrated in a report just issued by the survey, that in spite of the long familiarity of manufacturers and industrial men in general with most of these rivers, the water resources they afford have not yet been appreciated and by no means developed to their fullest extent. In fact, there are very few rivers in this great region in which the developments of water power have come anywhere near the maximum possible degree of their usefulness.

THE REGULATION OF ALTERNATING-CURRENT GENERATORS AND COMPARISON OF THE METHODS USED IN CALCULATING IT.

BY FRANK J. KENNY.

The discrepancy which exists between the results obtained by calculating the regulation of alternating-current generators by various methods doubtless is well known. This difference has always existed and always will exist, because one method takes into account factors which the others do not. The American Institute of Electrical Engineers has recommended that regulation be calculated according to the "magnetomotive-force" method and this comes as near to being a standard method as it is possible to obtain at present. It has been found, however, that this method has its limitations and does not give very consistent results at power-factors differing very much from unity; hence some other method may be employed which seems to check better with actual tests.

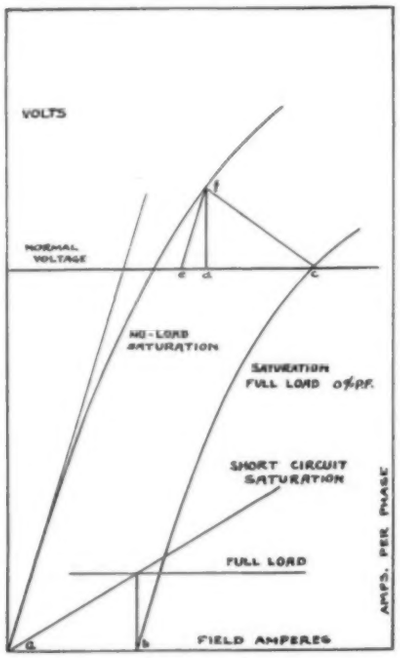


FIG. 1.

For this purpose the method described by E. Arnold in his *Wechselstromtechnik*, Vol. IV, or a modification of his method, is sometimes used. Either of these will generally show better results at power-factors below approximately eighty-five per cent.

Another way to calculate regulation is by the electromotive-force method, which is seldom, if ever, used, because it gives pessimistic results that would be practically unobtainable in a machine which made any pretense at all of being well designed. It is mentioned here merely because the purpose of this article is to compare the various methods.

A no-load saturation, a full-load, zero-power-factor saturation and a short-circuit saturation are the curves necessary to obtain the regulation of a given machine. As shown in Fig. 1, the lower part of the saturation curves are drawn straight, and on the no-load curve, the straight line is continued a short distance beyond the normal-voltage point. This is called the "air-gap line," as it represents the number of amperes—and hence ampere-turns—necessary for the saturation of the air gap alone; when the *iron* becomes saturated, an additonal number of ampere-turns must be supplied to force the flux through it, therefore the curve tends to bend over.

The short-circuit saturation is plotted with terminal amperes per phase and field current. The horizontal line indicates the value of full-load amperes (per phase) and a line dropped perpendicularly from the intersection of the two will give the amount of field current used to overcome armature reaction at full load, zero power-factor; hence this is the starting point of the full-load, zero-power-factor saturation curve.

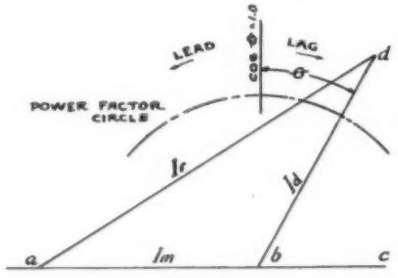


FIG. 2.

Take this value of field current (call it *a b*) and lay it off on the normal-voltage line (*e c*) from the zero-power-factor saturation curve towards the left; at the point *e*, draw a line parallel to the air-gap line and cutting the no-load saturation curve. A perpendicular from the normal-voltage line to the intersection of the above two, will give the reactance voltage of the generator, *d f*. The value in field amperes required to overcome the armature demagnetizing amperes at zero power-factor is equal to the distance *d c*. Though approximate, the values found by the above method check well with the calculated results.

To begin with the magnetomotive-force method; the procedure to calculate regulation (praphically) is shown in Fig. 2. On a horizontal line *a c*, the field current corresponding to terminal voltage plus armature resistance drop, is laid off ($=ab=I_m$); at the point *b*, a semicircle called the power-factor circle is described with any convenient radius, and various power-factor values are stepped off on its periphery, corresponding to cosine of the angle Φ. The left-hand side will give results corresponding to leading, and the right-hand side to lagging, power-factors. The field current required to produce normal current per phase on short-circuit, ($I_d = b\ d$, Fig. 2) is laid off at the angle coinciding with the power-factor at which the regulation is desired, and the resultant, I_r, is the field current required to produce normal voltage at full load with the power-factor used above. The voltage produced by such a value of field current, read from the no-load saturation curve, is the voltage which the machine would generate were the load thrown off. The difference between this voltage (E_o) and the normal voltage of the machine (E_t), divided by E_t, multiplied by 100, is the regulation in per cent.

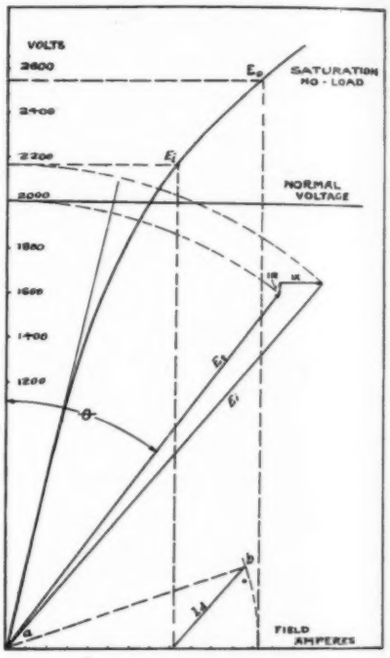


FIG. 3.

Regulation in per cent $= 100\ (E_o - E_t)/E_t$.

To calculate the regulation mathematically, let I_m = field current required for normal voltage on open circuit plus

the $I\ R$ drop produced in the armature.

I_d = field current required for normal current on short-circuit.

Then if I_r be resultant field current,

$$I_r^2 = I_m^2 + I_d^2 + 2\ I_m I_d\ \sin\ \Phi$$

This value will check with that determined graphically.

The reason why a leading power-factor (above approximately ninety-seven per cent) gives a negative regulation is because the demagnetizing ampere-turns of the armature assist the useful pole flux, thereby producing normal voltage with less field current than is required at unity power-factor. Consequently, when the load is thrown off, the field current is unable to maintain the voltage, causing a drop in voltage, or giving a negative regulation. A leading power-factor of approximately ninety-seven per cent will give zero regulation.

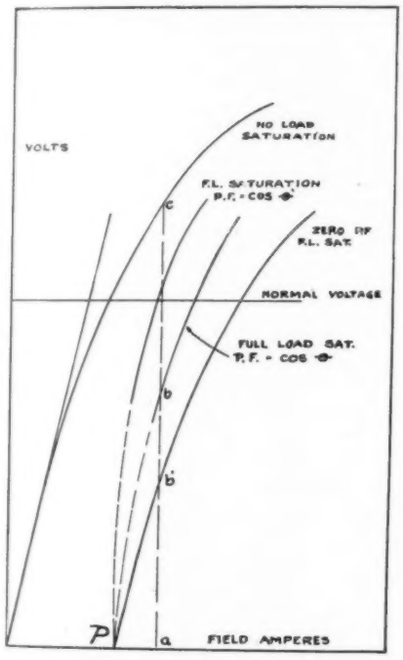


FIG. 4.

Arnold's method may be explained by the use of Fig. 3. The normal voltage of the machine, E_1, is laid off so that the the $cos\ \Phi$ is the power-factor at which regulation is desired.

Vertically, from the extremity of E_1 the $I\ R$ drop of the machine is added, and horizontally the $I\ X$ drop; the resultant, E_0, being the induced electromotive force of the machine. From the point where a perpendicular line drawn from the saturation curve (at the voltage E_1) cuts the horizontal axis, the line I_d, representing the demagnetizing amperes, is drawn parallel to E_1. With a radius equal to ab, an arc is struck from the extremity of I_d to the zero-voltage line and the electromotive force induced by this value of field current is the voltage to which the machine would rise were the load thrown off. For a machine having a saturation curve corresponding to that shown in Fig. 3, the regulation would be

100 (2550—2000)/2000 = 27.5 per cent at 80-per-cent power-factor.

Two of the factors which make this

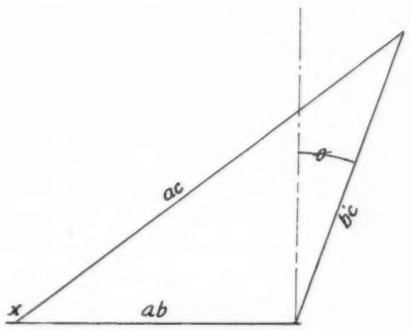


FIG.. 5.

method approximate, are the $I\ X$ drop and the armature demagnetizing amperes. The only practical way to obtain these, experimentally, is from the curves in Fig. 1, $d\ f$ being the former, and $c\ d$ the latter. Since, as it was stated previously, these values check with the calculations, not much error will result from using them.

A modification of the above method consists in plotting the saturation curves for full load with varying power-factors. These curves are obtained from the no-load and full-load zero-power-factor saturation curves, as follows:

The vertical distance between the two curves, $b'c$ (Fig. 4) at any convenient point a, is laid off from a horizontal line $X\ Y$ (Fig. 5) and at an angle Φ from the vertical, so that $cos\ \Phi$ equals the power-factor for which the curve is being plotted. The distance between the no-load curve and the horizontal axis ($= a\ c$) is then laid off backwards from the extremity of $b'c$ (Fig. 5) till it intersects the line XY. This distance, ab, when erected perpendicularly from a (Fig. 4) will give one point (b) on a full-load saturation curve with power-factor = $cos\ \Phi$. In like manner, other points may be obtained and the curve drawn in. The saturation curves for other power-factors may be obtained in a similar manner by simply varying the angle Φ (Fig. 5) to correspond. All these curves will converge at the point P.

To take the $I\ R$ drop of the machine into account, multiply it by $cos\ \Phi$ and subtract it from ab (Fig. 5).

It will be seen (Fig. 4) that these curves will give varying values of field current where they cut the normal voltage line and the voltage produced by this current (E_0)—read from no-load saturation curve—is that to which the machine would rise were the load thrown off. The regulation is found in the usual manner.

The distance between the curves ($b'c$) is the voltage required to overcome the armature reaction of the machine, corresponding to the conditions under which the saturation curve was taken; *i. e.*, full load, zero power-factor. The distance $a\ c$ is, of course, the open-circuit voltage for the same point. Subtracting these values, vectorially, gives the full-load voltage at the power-factor used, for the same point (a).

Fig. 6 shows the "electromotive-force" method of determining regulation, which differs from the others in as much as it requires in addition to the no-load, full-load saturation, and short-circuit curves,

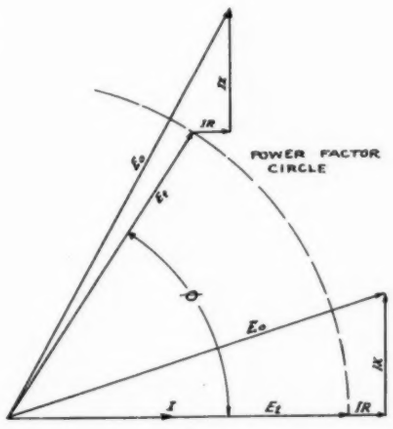


FIG. 6.

a "synchronous-impedance" curve, which is determined experimentally as follows:

The machine is driven at synchronous speed, with the armature short-circuited and the field excitation adjusted to give normal current output. The short-circuit is then opened and the voltage read on an open circuit with the same speed and excitation. The values of normal current output are plotted against voltage on open circuit. We thus obtain a curve from which we can read the IX drop of the machine for any current output. Another way to obtain this synchronous-impedance curve is by combining the no-load saturation and short-circuit curves.

For a definite current output on short-circuit a certain field current must be supplied as given from the short-circuit curve. Now read from the no-load saturation what open-circuit voltage will be obtained with this value of field current. Plotting this voltage against the current output used, a curve will be obtained similar to one made from the above tests. Therefore to find E_0 it is only necessary to combine the IR drop, IX drop, and the terminal voltage E_t, vectorially, as is shown in the figure, the angle Φ corresponding to the phase displacement. The regulation is found in the usual way.

The regulation of a number of machines was determined by each of the foregoing methods and the results obtained were similar to the curves shown in Fig. 7. As the modification of Arnold's method gives results similar to Arnold's method itself, they have been

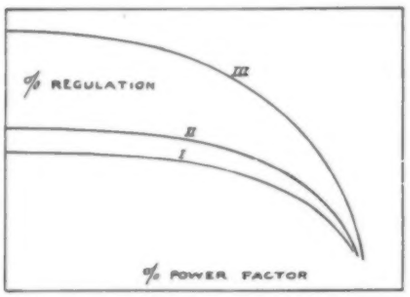


FIG. 7.

averaged and plotted in II; I being the magnetomotive-force method and III the electromotive-force method. These curves show why the magnetomotive-force method is called the "optimistic" and the electromotive-force method the "pessimistic" method. The end of curve I for the higher power-factor coincides fairly well with II; and only at eighty-five to eighty per cent do they commence to show any marked difference. III gives results which are well nigh impossible.

It might be said, in conclusion, that for practical purposes the American Institute method will give results which are quite satisfactory; but where it is desired to obtain a nearer approximation to the probable regulation, Arnold's method will give better results.

Virginia Coal Output Increasing.

Coal mining in Virginia has made important increases within the past generation. Although not a great coal state Virginia produced over six and a half millions tons in 1910.

Helium Tubes as Light Standards.

At the meeting of the Philosophical Society of Washington on November 11, a paper was presented by P. G. Nutting on "Helium Tubes as Light Standards."

The investigation of the properties of electrically conducting gases with a view to their possible use as primary standards of luminous intensity has been in progress at the Bureau of Standards for the past six years. A summary of the results obtained is given below.

Of the available gases and vapors, helium is the only one emitting light of a suitable color and having reasonable lasting qualities. The light is of a yellowish white, approximately that of the Hefner flame and of an old-type carbon-filament glow lamp. The useful life of a helium tube is from 5 to 100 hours depending on its construction and operation. The next best gases would be carbon dioxide and sulphur dioxide, but these emit a snow-white light and disappear rapidly in carrying a current.

The form of tube found most suitable has a capillary portion of two-millimeters bore, two-millimeters thickness of wall and is about seven centimeters long. The terminal bulbs are thirty-five millimeters in diameter and spherical, while the electrodes are aluminum disks one millimeter thick and twenty-five millimeters in diameter. Recent results indicate that possibly a slightly increased bulb diameter might give longer life to the tubes.

The relation between current and light emitted is very nearly linear over a wide range of intermediate currents, 10 to 35 milliamperes. Twenty-five milliamperes was chosen as the most suitable standard current.

The ratio of light emitted to internal energy (current times potential gradient) is not quite constant. The minimum watts per candle for a tube of two millimeters base, namely, 3.8, occurs at a current between 25 and 30 milliamperes. Owing to the large and uncertain variations in the potential gradient and the difficulties in its precise determination, attention was directed toward expressing light in terms of current and bore rather than in terms of internal energy.

The light emitted by a helium tube as a function of current was later determined line by line for each of the six prominent spectrum lines. These all behave nearly alike, increasing with current sensibly as does the total light. Helium shows no trace of any secondary spectrum in the visible region.

Neither the voltage nor frequency of alternation of the exciting current affect the light emission by a measurable amount. Voltages of 1,000, 2,000, 5,000 and 10,000 were used and direct-current, 60-cycle and 900-cycle alternating current.

Gas density does not affect the specific light emission over a range from 3 to 8 millimeters pressure, provided the bore of capillary is not much over two millimeters. With 25 milliamperes through two-millimeters-bore, the light is sensibly independent of gas density from 3 to 8 millimeters pressure. Chiefly for this reason these specifications and 4 to 7 millimeters pressure were adopted for the standard tubes inasmuch as gas density is difficult to control and determine in such tubes.

The correction to the light emitted by a centimeter length of capillary for slight departures from two millimeters in the bore was carefully determined. It is —0.010 candlepower per centimeter for each +0.1 millimeter difference in bore from 2.00 millimeters.

A test of reproducibility was made on a set of forty tubes. The capillary portions of these tubes were specially prepared and selected by Baudin to secure the utmost possible uniformity of bore and wall and freedom from striations. The tubes were made up and filled at the Bureau of Standards in Washington.

Color reproducibility was determined by intercomparing the spectra of these tubes line by line with the spectrophotometer. The slight variations observed were well within the errors of observation.

Photometric observations on the mean horizontal candlepower per centimeter length of capillary were made by four experienced observers. The computed probable error for all observers and all the tubes was 0.16 per cent. The average deviation of the tubes from their mean value was 1.15 per cent, the maximum deviation 3 per cent.

A letter box placed on the junction of two principal streets in Victoria, B. C., came in contact with the wires belonging to the lighting circuit recently. Several people who used it were severely shocked.

MEASUREMENT OF ELECTRIC ENERGY BY ELECTROLYTIC METERS.

BY JOSEPH B. BAKER.

The operation of electrolytic meters is based on the fact that the quantity of electricity traversing a circuit may be measured by the chemical work done by the electricity in passing through an electrolytic cell connected in series with the circuit.

The electrolytic meter thus utilizes the principle of the voltameter, which is susceptible of application in the laboratory to the making of very exact determinations of quantity of electricity,

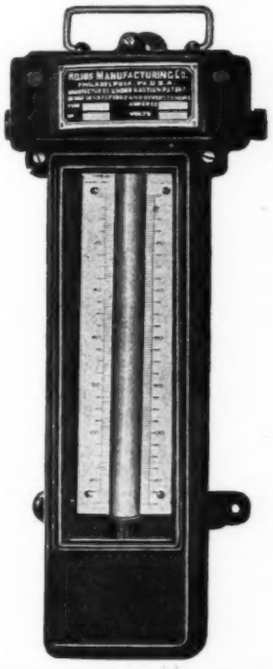


FIG. 1.—THE BASTIAN ELECTROLYTIC METER.

or of average strength of current during a given elapsed time. But meters of this type take no direct cognizance of the voltage of the circuit to which they are connected, and hence are not adapted to the measurement of electric power.

They may be illustrated sufficiently by the two examples, the Edison "chemical meter" and the Bastian meter, both of which are essentially coulometers for use on direct-current circuits.

The Edison meter, which was formerly in general use, but which has been displaced by meters of the motor type which give direct readings in watt-hours, consisted of an electrolytic cell in which a definite shunted portion of the current supplied to the consumer was made to deposit zinc upon a zinc cathode. The quantity of electricity was computed from the increase in weight of the cathode, and the meter served to measure watt-hours when used on a constant-potential circuit.[1]

The Bastian meter, which is in actual commercial use, differs from the Edison meter in giving direct readings on a scale; the product of electrolysis being a gas which displaces the electrolyte in a vertical calibrated tube.

The Bastian Meter consists of a graduated glass tube of electrolyte with a bulb at the bottom containing nickel electrodes of proper size for the rated carrying capacity of the meter. The passage of current causes decomposition of the electrolyte, and the evolution of gas (oxygen and hydrogen) which is evidenced by a lowering of the level of

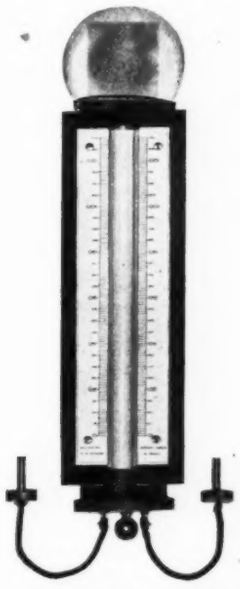


FIG. 2.—TUBE OF BASTIAN METER.

the electrolyte on the scale. A fixed quantity of caustic soda is added to reduce the voltage drop through the meter and to prevent risk of freezing. Evaporation is prevented by a little oil on top of the column of electrolyte, and the escape of moisture with the evolved gas is prevented by a lead cap resting by its own weight on the ground top of the tube.

The layer of oil present serves also to define the level of the electrolyte and thus facilitate the accurate reading of the scale. The counter electromotive force of the electrolytic cell is stated to be about 1.7 volts, and the total average drop due to resistance and the back electromotive force is stated to be kept within 2.0 volts by the low resistance of the solution and the ample size of the electrodes. The maker's catalog dwells upon the advantages of the accuracy of the meter on light loads, such as small desk fans and turn-down lamps, and the absence of shunt losses, moving parts, and repairs.

In older styles of electrolytic meters, platinum electrodes were used and the electrolyte consisted of a very dilute solution of sulphuric acid.

The meter is constructed for use on 110, 220 and 500-volt circuits. For three-wire service, two recording elements inclosed in a single case are employed; one is connected in each of the outer mains and shows the consumption on that side of the circuit. The meter must be filled with water "once or twice a year."

1 The reader who may desire further information on this meter will find an instructive account in "American Meter Practice," by Lyman C. Reed, McGraw Publishing Company, 1903.

New York Subway Work Active.

The city of New York has now under construction about eleven miles of new subway lines which will contain forty-four miles of single track underground railroad, and will cost in the neighborhood of $52,000,000. This is $17,000,000 in excess of the original contract for the existing subway. Of this total, seven miles of road, which will cost about $36,000,000, lies in Manhattan and four miles, to cost about $16,000,000, in Brooklyn. Of the work in Manhattan more than a mile is comprised in the Brooklyn Loop Subway, which is entirely completed, with the exception of the terminal section at Park Row, and which will have cost, when finished, about $10,000,000. The other six miles of road lies in Lexington Avenue and is part of the Broadway-Lexington Avenue line, upon which work has recently commenced. Bids for the Lexington Avenue contracts, so far let, aggregate more than $26,500,000.

These three subways, when completed, with certain branches in Brooklyn, Queens and the Bronx, will form the so-called Tri-Borough System, which will finally embrace about fifty miles of road and more than 150 miles of single track. The estimated cost of construction of the whole system is about $150,000,000. When placed in operation the new road should be able to carry comfortably approximately 1,000,000 passengers a day.

Sixteenth Annual Meeting and Dinner of the Electrical Credit Association of Chicago.

The sixteenth annual meeting and dinner of the Electrical Credit Association of Chicago, held on November 16, at the Chicago Athletic Association, was eminently successful from every standpoint. As has been customary, the business meeting held in the afternoon, was followed by a banquet at which about 130 were present. The program of toasts included four delightfully entertaining and instructive addresses and the entire assemblage was unanimous in voting the affair the most successful in the history of the Association.

The business meeting was called to order at 2 p. m. by Vice-President Kuehmsted, who in the absence of President Pierce, conducted the meeting.

The report of Secretary Vose, which was the opening business, gave some indication of the extensive nature of the work carried on by the Association. The total number of delinquents reported since the Association was organized is 32,320 which represents an indebtedness of $2,484,916.89. The total number of claims settled during 1911, is 2,398 and since 1896 a total of 19,551 claims have been settled. The Association handled $12,841.83 during the past year. The balance in the general fund October 31, 1911, was $2,895.42.

Interesting papers were then presented as follows: "Disputed Accounts and the Executive Committee," by A. O. Kuehmsted; "Keeping Faith," by W. A. Brady; "Reporting Municipalities," by E. E. Ingels; "Forms and Model Letters," by F. D. Van Winkle; "Does the Association Pay?" by S. E. Kennedy, and "Contractors as Credit Risks," by E. R. Gilmore. The general sentiment prevailing, particularly among the jobbers, was that customers should be held strictly as possible to the terms of sale, as is done in other lines.

In the paper by E. E. Ingels on "Reporting Municipalities," and in the discussion which followed it was the consensus of opinion that while it is preferable not to report municipalities as delinquents, still some method should be adopted for notifying members when cities are paying by warrant. It was pointed out that in many cases where warrants were tendered a year and often two years elapsed before the payment was made. It is important that the smaller dealers, at least, should be notified of this and the Association instructed National Representative Wolff to present the matter at the next National meeting.

In the paper on "Contractors as Credit Risks," presented by E. R. Gilmore it was admitted that the small electrical contractor was by far the worst credit risk in the industry. This is due to many conditions principal of which is the lack of ample capital. Contractors unlike jobbers or other merchants have all their money invested in material going into a job or several jobs and cannot get any returns until the last switch plate is polished. Other conditions which tend to make the contractor a poor risk, according to Mr. Gilmore, is his inexperience in selling, inattention to bookkeeping and slowness in making concessions. Mr. Gilmore and also those who discussed this paper agreed that the manufacturer and jobber should each assume a share of responsibility in the development of the contractor, assisting him in making sales and estimates, instructing him in proper bookkeeping and lending assistance in collecting accounts. For the responsible contractor it was advocated that he be encouraged in handling electrical appliances and devices in his town and that the manufacturers and jobbers turn over local business to him.

The election of officers for the ensuing year resulted as follows:

President, S. E. Kennedy, Central Electric Company.

Vice-president, A. O. Kuehmsted, Gregory Electric Company.

National Representative, James Wolff, New York Insulated Wire Company.

Secretary and treasurer, Frederic P. Vose, Chicago, Ill.

ANNUAL DINNER.

Seats were taken promptly at 6:30 p. m. At the conclusion of a very excellent repast Vice-president Kuehmsted in a brief address welcomed the delegates and guests and then introduced S. E. Kennedy, newly elected president of the Association. After thanking the members for the honor they had conferred upon him. Mr. Kennedy introduced A. A. Gray, toastmaster, who conducted the evening's events.

The first speaker of the evening was William J. Hagenah, public-service expert and statistician, who delivered a remarkably interesting address on the subject of "The Regulation of Public Utilities." Mr. Hagenah stated that the desire for regulation is not new, but dates back to the Middle Ages. He stated briefly the conditions which lead up to the demand for regulation which, particularly in the electrical industry, are superficial notions as to exorbitant rates, over capitalization, etc. A public-service company should be a monopoly and as such there are three conditions which the company should fulfill. The first is good service, the second reasonable rates and the third non-abuse of the privileges which the public grants it.

A public-service corporation is entitled both by common law and by statute to a reasonable return upon its investment. If given rate schedule yields more than a reasonable return to the investor it is an injustice to the public and the rates should be lowered. If the rates fail to produce sufficient revenue the investor is not receiving that return to which he is entitled by law. Mr. Hagenah stated that there was a difference of opinion as to what constitutes a reasonable return; he considered eight per cent a fair return.

Rates should be based on a fair valuation of the property. In making a valuation both tangible and intangible value must be considered. Under the former an inventory of the entire property must be made and the cost of the original plant, present value, earning capacity, etc.

In arriving at the intangible value of a property many difficulties are encountered. First, a company cannot capitalize its franchise against the public. Mr. Hagenah states that if a franchise has value then the company is earning money above a fair return on the investment. A franchise therefore cannot be considered. "Good will" must also be ignored. Good will in law implies a choice on the part of the individual. As a public-service company is a monopoly no choice is allowed the public.

Going value, however, must be considered. Mr. Hagenah stated that new plants seldom yield a return on the investment during the first year of operation. In fact, it is more likely to require a number of years of continuous effort to establish a business on a firm basis. The history of public utilities clearly shows that many of such

plants have not reached a position of profit to the investor until many years after their construction. During the earlier years a large amount of money is required for development purposes.

The amount by which the earnings fail to meet the operating expenses and the return on the investment creates deficits which constitute the cost of building up the business. Just as supervision, interest and insurance during construction are expenditures to be added to the construction cost of the plant, so the deficits representing the amounts by which the stockholders have failed to receive their reasonable return are costs to be added to the value of the physical plant in order to show the complete investment which has been made in the industry as a live, going concern. The investor has a right to expect reimbursement for such losses. They are legitimate costs of business.

In conclusion Mr. Hagenah said that the only satisfactory manner of solving the public-utility-regulation problem, with satisfaction to both the companies and the public, is to establish commissions such as now exists in Wisconsin. These commissions should be composed of experts, appointed for long terms and given attractive salaries, also sufficient funds should be appropriated to carry on the work as it should be done.

J. R. Kline followed with an eloquent address on "The Measure of a Man." Special Assistant United States District Attorney Parkin delivered a very forcible address on "The Sherman Act in Business," in which he briefly traced the history of this act and appealed to the public to consider it as the Supreme Court has interpreted it. The affair was brought to a close by the very entertaining recitations of Harry A. Antram, entitled "Hoosier Harpings."

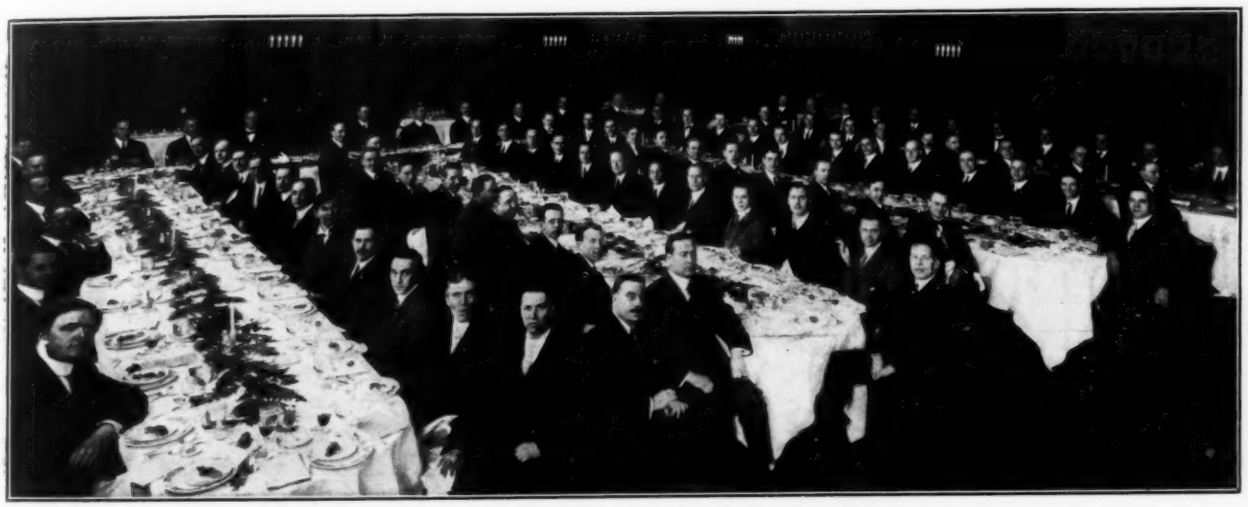
Australian Institute of Electrical Engineers Formed.

A new organization, to be known as the Australian Institution of Electrical Engineers, is being formed by the Electrical Association of New South Wales and the Victorian Institute of Electrical Engineers. The advantages to the two societies through affiliation are said to be: (1) Joint action could be taken when necessary; (2) all bodies affiliating must incorporate and adopt similar rules; (3) conferences might be arranged as thought desirable; (4) a convention might be held at intervals of not less than two years, the expense to be met by a per capita call upon each branch of the Institute; (5) members would gain certain stated privileges.

Each society will retain its present organization, with a change in name. Societies in other geographical subdivisions may be admitted by ballot.

An English Wind-Power Idea.

C. Orme Bastian refers in a letter to the *London Times* to a method of utilizing wind power to supply electricity for heating and cooking in the household. Mr. Bastian proposes that power generated by a windmill on the housetop should be converted to heat in the resistance coils of electric fireless cookers, etc.



BANQUET OF THE ELECTRICAL CREDIT ASSOCIATION OF CHICAGO.

THE TALKING PICTURE AND THE STAGE.

BY ROBERT GRAU.

The stage in the second decade of the twentieth century, potent and progressive as it is, has now been confronted with perhaps the most difficult problem with which it has as yet had to cope in the advent of the so-called talking picture, a device now having a tremendous vogue in Paris, and about to be the attraction in every European capital. Moreover, two of America's most prominent theatrical managers have been competing with each other for the American rights of what is expected to prove the sensation of the next theatrical season.

A few years ago, when the moving picture first began to be a factor in this country, its vogue was regarded as of short duration, and few were willing to believe that it would create the greatest upheaval in theaterdom yet recorded. Yet it is a fact that the motion picture has survived to become the most lucrative line of endeavor in the history of public entertaining.

In the last five years the vogue of the camera man has served to bring 10,000 theaters in this country into being and prosperity, and has made millionaires of a dozen men who came into the amusement calling in the last decade without training or incentive. The moving picture has solved the problem of more than one-third of New York's regular theaters, an achievement sought for by their directors for the last twenty-five years without success.

The tremendous scope of the film-production industry has resulted in thousands of actors and actresses now finding lucrative employment, for it is a fact that no less than sixty fully equipped stock companies are now in activity in this most propitious field.

The question, however, arises as to the effect the talking picture will have on the player, if it is found that the effort to present plays and operas and even vaudeville specialties with voice, action, color and even dialogue concretely reproduced, is successful. We must believe that this result has been achieved, when a manager of the prestige possessed by Henry W. Savage contracts for the American rights, and that, too, by outbidding Charles Frohman. Súrely the advent of such men in the field of artificial production constitutes a new and unique era in the field of the theater!

Thomas A. Edison made the prophecy less than a year ago that within a very short time the workingman would lay down his dime in the modern moving-picture theater box-office and witness an almost perfect reproduction of the grand operas which have been possible heretofore only to those who could afford the high prices of admission prevailing at the Metropolitan Opera House.

The talking picture will bring to our doors such massive and exclusive productions as the Oberammergau Passion Play, which has heretofore entailed a pilgrimage to the Bavarian city, and an outlay such as few only could afford. It will also now be possible to hear in this country new operas and great spectacles, requiring so many persons to portray them that the transportation expense alone has prohibited their being seen here.

The regular theater has surely suffered as a result of these scientific devices, for the past theatrical season is acknowledged to have been the worst in amusement history. If the next theatrical season is not an improvement at the box-office, the men to whom the American public look for their high-class entertainment will be brought face to face with the problem of meeting their obligations.

Pride is possessed by the theatrical manager in abundance, but when Klaw and Erlanger permitted the New York Theater to be transformed into a picture resort, where twenty-five cents is the highest price for seats, they simply found a way to make both ends meet on a property, the fixed charges of which are nearly $100,000 a year. The moving picture alone seems potent enough to bring the revenue, and we may look for the absorption of some of the Broadway theaters for the same purpose. Two of the largest firms operating in theaterdom have with much ingenuity prevented disaster for themselves by recognizing the trend of things, and turning the majority of their theaters into the gold-laden moving-picture field, with a result so decisive, that others are now planning to emulate them, not only in New York, but all over the country.

Fifty million dollars are now invested in the motion-picture industry, and as much more is seeking investment by men who have heretofore refrained from entering the show world, but have been finally attracted by knowledge of the fortunes already made by such men as George B. Cox, Joseph L. Rhinock, Felix Isman, Timothy D. Sullivan, Nixon & Zimmerman, Marcus Loew (who began five years ago in Harlem in a penny arcade and is now a multi-millionaire) and William Fox, who in the short space of four years has become immensely rich and now controls a dozen theaters in Greater New York alone.

One may only conjecture as to the part the talking picture is to play in the show world, but the fact that such managers as Henry W. Savage and Charles Frohman are found in fierce competition for the American rights of the device, now so potent at the Olympia in Paris, proves that the significance of the scientific reproduction of plays and operas on the screen, is no longer questioned by the men who have been most affected by its evolution.

VEHICLES IN ELECTRIC PLEASURE CAR PARADE.—LEFT HALF.

Electricity has played the most vital part in what has been achieved with the talking picture. It is even claimed that the present European tour of the Wizard of Menlo Park has been greatly due to the success of the French invention, and now London is raving over the Edison Cinephonograph and Mr. Edison himself has announced the realization of all his hopes.

The advent of the spoken word simultaneously with the portrayal on the screen of the action of a play must mean a vivid spectacle, and it should be easy to imagine the furore that will be created in this country when the silent drama is thus replaced.

In the last year the motion-picture theaters have been greatly enhanced in their offerings by the novel and unique sound effects which simulate nature so well as to emphasize the verity of the portrayals on the screen, and it is the availability of these sound effects that has justified the film manufacturers in releasing special reels, such as the "Dante's Inferno" and "The Crusaders." One must believe that with as high as $100,000 expended to produce a single moving picture, such as those named, we are emerging into an era of great expansion in scientific research, and it is the electrical phase of present conditions that has made for the greatest progress. This is so true that where ten years ago not a single large firm in the electrical field catered to the theatrical trade, today a dozen large corporations deal exclusively in electrical apparatus.

Time was when only the actor was praised in a theater, then the author came to his own, and now the electrician is a vital factor. Recently at a first night of a spectacular play in New York the audience demanded the appearance before the curtain of the house electrician, a custom by no means unusual in Europe.

No better evidence of the part electricity is playing in the progress of the stage can be presented than the fact that the General Electric Company employs a special expert whose province it is to go any distance in order to enlighten theatrical producers as to the many novel and epoch-making apparatus recently evolved by that company.

Electric Pleasure Car Parade.

A parade of electric pleasure vehicles, the first of the kind ever held in Boston, and which is more novel today than it ever will be again in Boston, took place November 15. Thirty-six members of the Electric Vehicle Club drove in electric automobiles from the Boston Edison Company's Building on Boylston Street, out through Beacon Street to The House of Edison Light at the corner of Pleasant and Centre Streets in Newton Centre for luncheon.

The House of Edison Light is a unique feature in itself, and General Superintendent W. H. Atkins of the Boston Edison Company invited the members of the Electric Vehicle Club to go out and enjoy their regular luncheon at The House of Edison Light, instead of in their usual meeting place on the seventh floor of the Edison Building.

Twenty-four electric pleasure cars, representing all of the seventeen agencies for these cars in Boston, were assembled in Head Place between 11 and 12 o'clock. Promptly at 11:45 the members of the Electric Vehicle Club, with a few invited guests, took seats in the cars and started in a parade out Boylston Street. The line was headed by the president of the Club, with another member of the Club as his passenger. Several officers of The Edison Electric Illuminating Company of Boston were in the party.

The twenty-four cars formed in line with The House of Edison Light as a background, and a panorama photograph was taken. The members of the party then adjourned immediately for luncheon, tables being laid in the different rooms of The House of Edison Light, which, although ample in proportion for ordinary living, were individually too small to accommodate so large a gathering of people around one table.

Following the luncheon came the regular business meeting of the Club. After the meeting adjourned at 3:30 the party returned to Boston as they came, in the electric cars, through Commonwealth Avenue and Beacon Street.

Everywhere the assembling of so considerable a number of electric cars made favorable impression on the pedestrians and passengers in other types of conveyances. The electric vehicle campaign which has been carried on so successfully in Boston during the past six months has developed a keen interest in this type of car, both for commercial and pleasure purposes, and it is a sure prediction that the assemblage of so considerable a number of cars will no longer be considered a novelty, but will become an every-day spectacle.

VEHICLES IN ELECTRIC PLEASURE CAR PARADE.—RIGHT HALF.

Electric Vehicles.

According to the results of the thirteenth census, preliminary figures of which have just been issued by the Census Bureau, the number of electric vehicles manufactured in the United States in 1909 was 3,639, having a value of $6,564,500, which is an increase of 160 per cent over the corresponding figures for the previous census of the year 1904.

Central-Station Practice

SWITCHBOARDS OF THE PEDESTAL, POST AND CONTROL-DESK DESIGN.—II.

BY STEPHEN Q. HAYES.

With the more recent designs of American control desks where it is desired to reduce the length of the operating board to a minimum, it is customary to install a continuous control desk and to mount on it the various controllers, circuit-breakers, field switches, field rheostats, etc. It is customary to mount the instruments for the various circuits in such a position relative to the sections of the desk, as to indicate clearly to the station operator the instruments belonging to any particular circuit.

With control desks the instruments can be mounted either on independent switchboards or on panels forming the back of the control desk, or on an instrument frame back of and usually higher than the top of the control desk, or on instrument posts. In some cases the instruments can be set directly in the face of the desk.

Where panels are used with a control desk, ordinarily the panels occupy a greater amount of space than the desk, and it is possible for the station operator to become confused in determining the instruments belonging to a certain generator or feeder whose controlling devices are on the desk. As a rule, card holders or name plates are placed both on the desk and the panels and the grouping of the instruments is made as far as possible to correspond with the grouping of the control devices. Where instrument panels form the back of the control desk, the instruments are, as a rule, arranged to correspond in location with the controlling devices for the same circuits.

A modification of this scheme is to use an independent instrument frame, and to arrange this frame at such a height that the station operator standing at the control desk, can look over the top of the desk and under the bottom of the instrument frame out into the station and thus readily observe the operation of the machine which he expects to control.

Fig. 13 shows an example of an early type of control desk that was furnished in 1899 for the St. Lawrence Construction Company's power plant at Massena, N. Y., and which was used for the control of a number of 3,750-kilowatt, twenty-five-cycle, three-phase generators and feeders. As may be noted from the photograph, this desk was provided with marble top placed on a wooden framework, and the push-button switches used for the control of the various breakers were arranged to form a miniature bus, each switch being provided with an electromechanical tell-tale device whose arrow showed whether the breaker was in the closed or open position. Bull's-eye lamps were provided to indicate the automatic operation of the circuit-breakers. With this control desk the main instruments were placed on instrument posts, while the synchroscope and three voltmeters were placed on the desk to facilitate synchronizing.

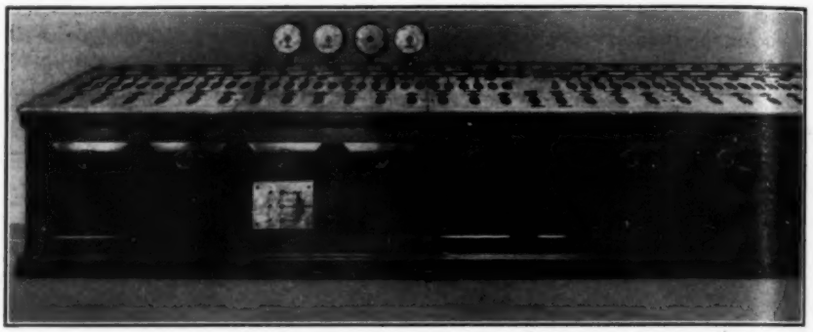


FIG. 13.—CONTROL DESK, ST. LAWRENCE CONSTRUCTION COMPANY.

Fig. 14 shows a somewhat later form of desk, supplied in 1901 to the Kingsbridge station in New York City. This desk was made with a marble top and marble front and sides, the whole being mounted on a metal framework. The portion of the desk shown in this illustration was for the control of the feeder circuits, which were arranged on the group system. The miniature bus on the top of the desk clearly shows the relative position of the group circuit-breakers and the individual circuit-breakers. As may be noted, each push-button switch is provided with an electromechanical tell-tale device, while the feeder circuit-breakers, which were au-

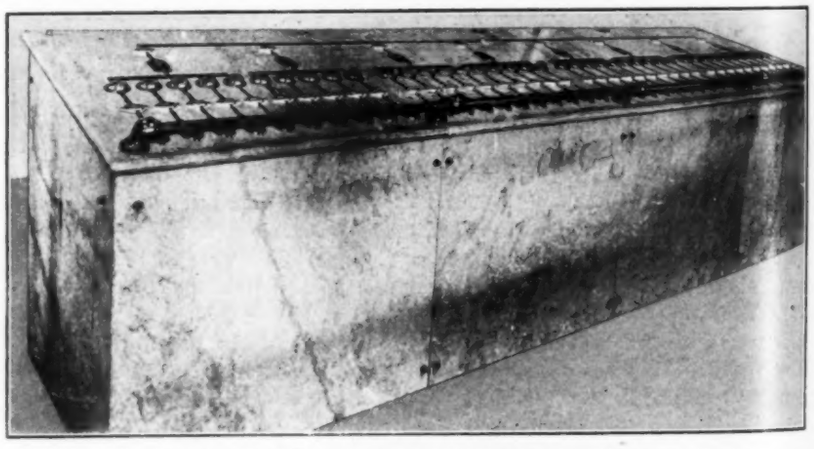


FIG. 14.—CONTROL DESK, KINGSBRIDGE, NEW YORK.

tomatic, had also bull's-eye lamps to show their automatic tripping.

Fig. 15 shows a still more recent type of control desk supplied to the Provincial Light, Heat & Power Company, of Montreal, for the control of five 3,750-kilowatt, 4,400-volt, three-phase generators, with provision for a sixth generator; two banks each of three 3,750-kilowatt transformers stepping up from 4,400 to 44,000 volts; two 44,000-volt feeder circuits; one 4,400-volt feeder circuit and provision for a second similar feeder. This control desk has a top slab 32 inches wide by 65 inches long and was provided with a miniature busbar system which, taken in connection with the red indicating lamps supplied with the circuit-breaker controllers, shows at a glance the connection made by the various breakers controlled from the desk. The instruments for the various circuits were mounted on standard-size switchboard panels which are placed at a short distance in front of the desk.

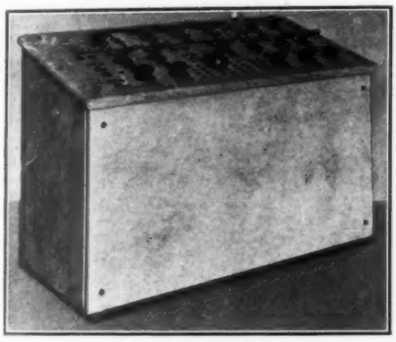


FIG. 15.—CONTROL DESK IN MONTREAL.

Fig. 16 shows the front-elevation drawing of the control desk supplied to the Williamsburg generating station of the Brooklyn Heights Railroad Company for the control of a number of large turbo-generators, the desk as shown being intended for the control of nine machines. The first three sections of the desk control generators 1, 2 and 3, while the next section controls the bus tie circuits between the group bus of these generators and that of generators 4 and 5. In a similar manner bus tie sections are placed between the sections for genrators 4 and 5, and the sections for generators 6 and 7, as well as between the sections for the latter and those for generators 8 and 9. Generators 1, 2 and 3 are of 7,500-kilowatt capacity and the others of 10,000 kilowatts, so that each section of main bus is fed from generators of a combined capacity of about 20,000 kilowatts. Each generator is provided with two electrically operated oil circuit-breakers in series with suitable disconnecting switches so that each generator can connect to its own feeder-group bus or to the main bus. This main bus is sectionalized by means of electrically operated oil breakers between generators 3 and 4, generators 5 and 6 and generators 7 and 8. Group breakers are also provided for connecting the feeder-group buses to the main bus. Each feeder-group bus supplies from three to six feeder breakers.

As may be noted, the generator instruments are placed on a framework above the desk so arranged that the station operator can readily watch the machines which he is controlling. Each generator section is provided with a field ammeter, an alternating-current ammeter, a polyphase indicating wattmeter and a power-factor meter, while

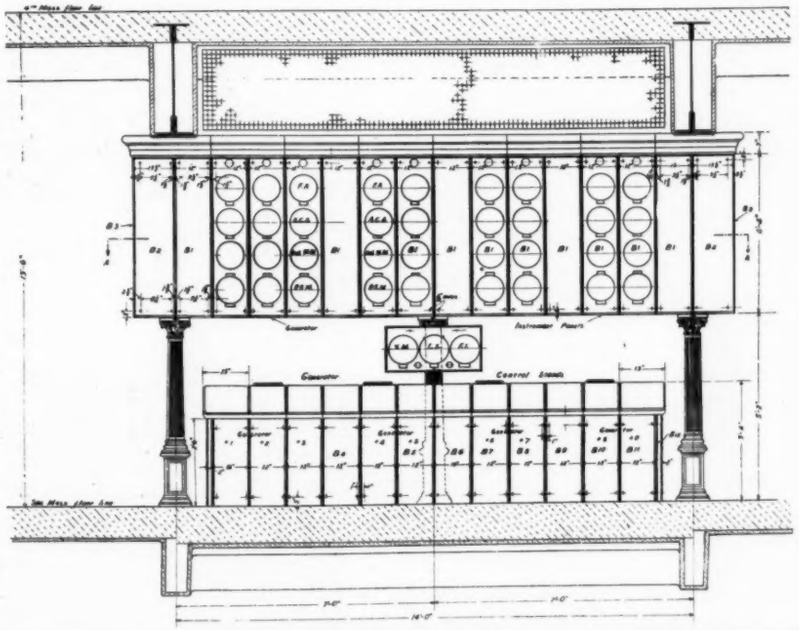


FIG. 16.—FRONT ELEVATION OF CONTROL DESK AND INSTRUMENT FRAME, WILLIAMSBURG STATION.

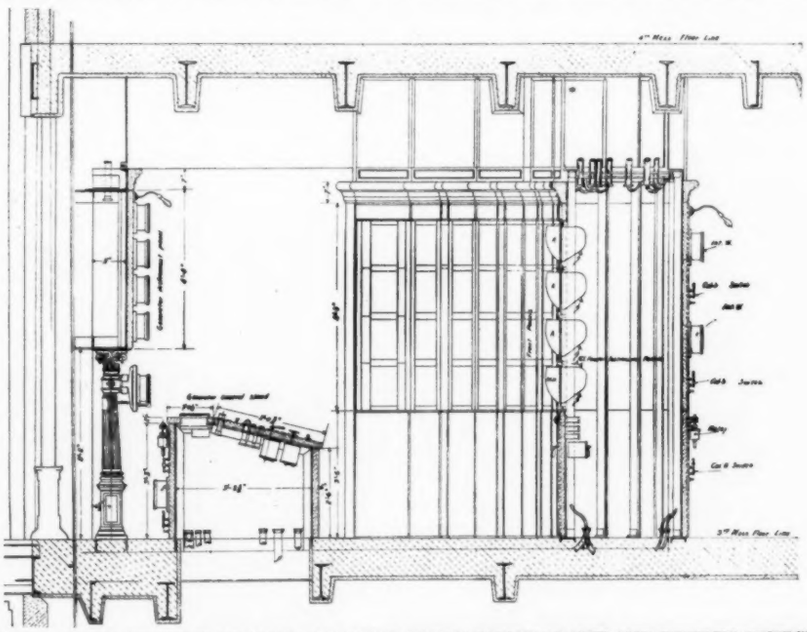


FIG. 17.—CROSS SECTION OF CONTROL DESK, INSTRUMENT FRAME AND FEEDER SWITCHBOARD, WILLIAMSBURG STATION.

a voltmeter was set in the top of the desk for one generator section in each group. A synchroscope, frequency indicator and voltmeter were placed on a pivoted slab attached to the center post of the instrument frame back of the desk.

Fig. 17 shows a sectional view of this same control desk, and indicates clearly the relative location of the desk and instrument board, as well as the location of the apparatus on the face of the control desk with the relays and similar devices on the back of the desk. The feeders in this installation are controlled from a vertical steel switchboard arranged in the form of an arc of a circle back of the control desk, so that the station operator turning around from the generator desk, can readily observe any of the feeder circuits. This feeder switchboard is made of two concentric boards placed back to back, the board on the concave side next to the generator desk containing the feeder indicating instruments of the vertical edgewise type, and the controllers and indicating lamps used with the electrically operated breakers of the feeder circuits, while the switchboard on the convex side contains the polyphase watthour meters, the overload relays and the calibrating switches supplied for the various feeder circuits.

Fig. 18 shows a control desk with blue Vermont marble top and steel plates for the front and sides that was supplied to the Carnegie Steel Company for the Youngstown plant. The round-pattern instruments are mounted on separate panels located back of and above the desk at such a height that the operator can look over the desk and under the instrument frame to observe the operation of the generators. This desk controlled four 2,000-kilowatt and one 1,000-kilowatt, 6,600-volt generators, two synchronous motors and four high-tension feeders. The desk is provided with a miniature bus to show the various connections. Hand-operated, distant-control field switches are used for the generators, while the field rheostats and oil circuit-breakers are electrically operated. The total length of this board is only eleven feet, and this type of construction makes a very compact arrangement. The leads to the instruments on the instrument frame are run through the hollow cast-iron columns that support the frame.

Fig. 19 shows a control desk eighteen feet long with an instrument frame back of and above the desk, which was furnished to a large plant at Rio Janeiro, Brazil, for the control of six 5,000-kilowatt generators, six banks of 88,000-volt transformers, four 88,000-volt transmission lines, as well as three waterwheel-driven and motor-driven exciters. In the plant for which this desk is used, the six transformer banks are each provided on the high-tension side with an electrically operated oil circuit-breaker, and a double set of disconnecting switches, so that a bank of transformers may be connected to either of the two sets of high-tension

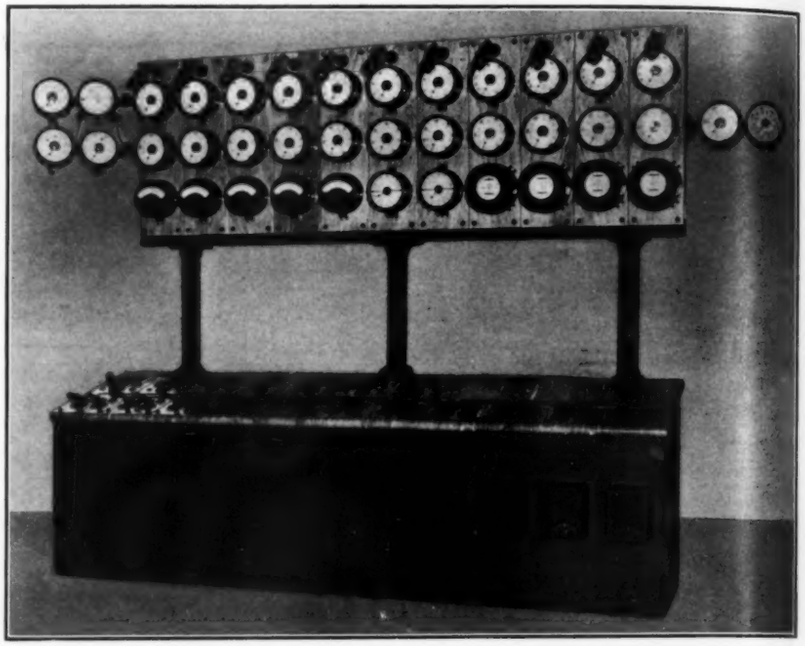


FIG. 18.—CONTROL DESK AND INSTRUMENT BOARD, CARNEGIE STEEL COMPANY.

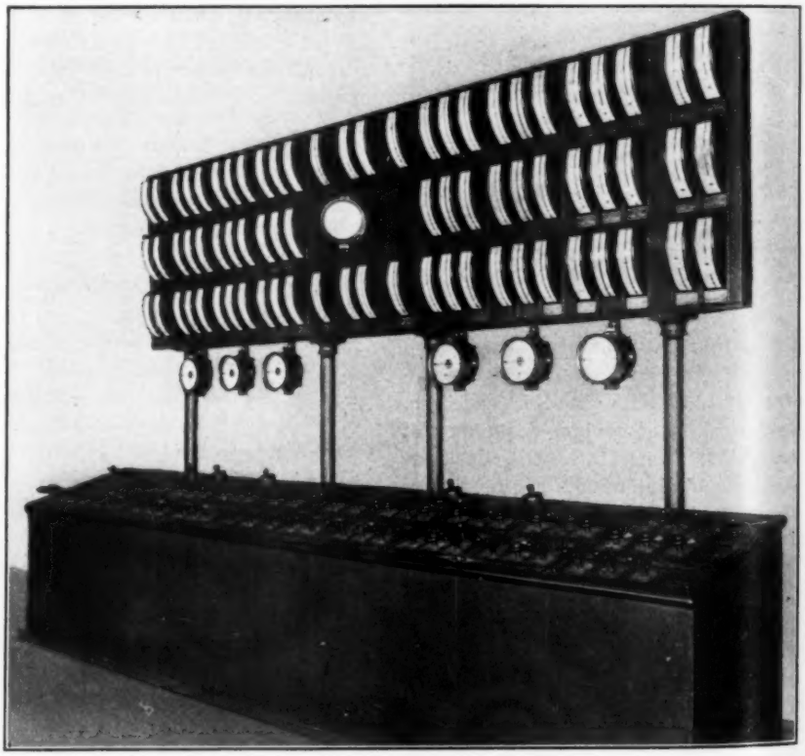


FIG. 19.—CONTROL DESK AND INSTRUMENT BOARD, RIO JANEIRO.

busbars. These two sets of busbars are divided in the middle but may be tied together by two electrically operated junction switches. The two sets of busbars on each side of the junction breakers may also be connected together by electrically operated tie switches.

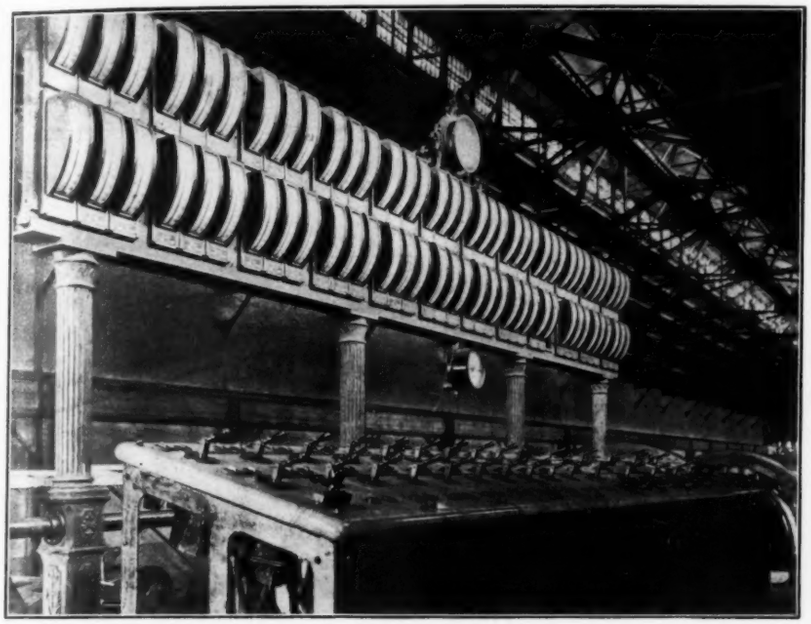


FIG. 20.—CONTROL DESK, PITTSBURGH RAILWAYS COMPANY.

The four outgoing transmission lines are each provided with an electrically operated oil circuit-breaker and a double set of disconnecting switches, so that the lines may be connected to either of the two sets of high-tension busbars. With this arrangement it is possible to operate the four transmission lines entirely independently and a very flexible combination of generators, transformers and lines may be obtained.

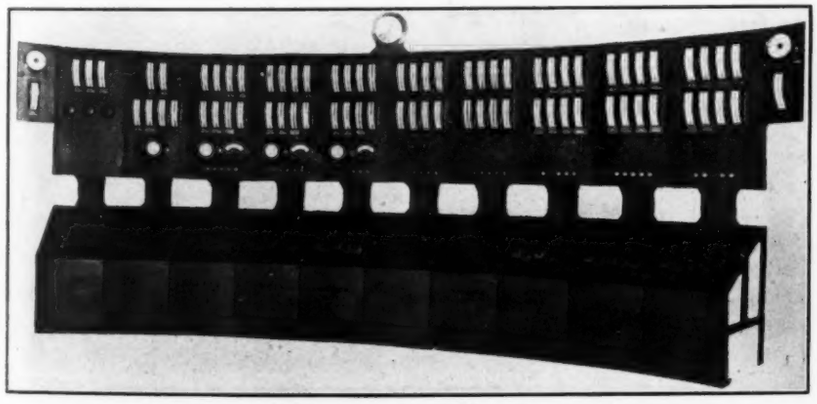


FIG. 21.—CONTROL DESK AND BOARD, BALTIMORE.

The top of this desk is made of marine-finished slate, while the end, front and back are made of planished steel plate, which is light, strong and readily removable to obtain access to the interior of the desk. The instrument frame is of steel and the unit idea has been carried out to allow for future extension.

This desk, like most of those where the connections are at all complicated, is provided with a miniature busbar system with the usual green and red lamps to indicate whether the breaker is open or closed. As the double-throw system on the high-tension side is obtained by means of disconnecting switches, similar miniature disconnecting switches are placed in the mimic bus. The idea is that the station attendant after closing or opening any of the high-tension disconnecting switches will report the fact to the station operator, so that the latter may set the miniature one to correspond. As the arrangement of the disconnecting switches is not likely to be changed from day to day, this scheme furnishes the operator with all necessary information as to the condition of the high-tension connections.

All of the controllers, etc., are mounted on top of the desk, the instruments being placed on the switchboard frame. With the exception of the power-factor meters where a 360-degree scale was desired, and the synchroscope where it is necessary for the needle to revolve, all of the meters, both alternating current and direct current, are of the vertical edgewise type with the same general appearance.

Fig. 20 shows the control desk and instrument frame installed in the Brunot's Island power plant of the Pittsburgh Railways Company for the control of a number of 13,200-volt generator and feeder circuits. Beginning at the left-hand end of the first five sections of control desk and instrument frame, each controls two three-phase feeder circuits, each of which can be connected to either or both of the two sets of busbars. Each feeder circuit has three 500-ampere alternating-current ammeters and is also provided with a pair of receptacles in which the plug shown on the extreme right-hand section is placed to connect that particular feeder to the power-factor indicator suspended from the middle of the instrument frame.

The next three sections of the desk are used for the control of three turbo-generators and the corresponding portion of the instrument frame for each generator is provided with three 600-ampere alternating-current ammeters, a 12,000-kilowatt polyphase indicating wattmeter, a 15,000-volt voltmeter and a field ammeter. The next section is for a slightly smaller machine and is provided with an 8,000-kilowatt wattmeter, while the two sections at the extreme right-hand end, are provided with 3,200-kilowatt wattmeters. The generator sections are equipped with handwheels and sprocket operating mechanism for use with the field rheostat and handles for two-pole, double-throw, distant-mechanical-control field switches. The type of framework used for the control desk and the instrument frame is clearly shown in this illustration.

Fig. 21 shows a control desk with vertical edgewise instruments supplied to the Pratt Street power house of the United Railways & Electric Company, of Baltimore, for the control of a number of 13,200-volt, twenty-five-cycle, three-phase generators and outgoing feeder circuits. This desk was arranged to form an arc of a circle and will ultimately be about twice as large as the portion shown. A complete miniature busbar system located on the top of the desk shows the connections made by the various circuit-breakers that are arranged on a group and ring system. In this plant each generator is provided with a circuit-breaker connecting the generator to a generator bus. This bus connects in turn through a main breaker to the main bus or through either of two group breakers to two group buses, each group bus supplying the current to four feeder circuits. By closing the various group breakers, the group buses form one complete ring bus and the main bus forms the second ring bus, so that a very flexible arrangement is secured. Calibrating jacks are installed on the front panels of the control desk to permit any of the switchboard instruments to be calibrated in position. The vertical edgewise instruments are mounted on steel plates forming the instrument frame, while the relays are located on the rear of the desk.

(To be continued.)

Preservative Treatment of Poles.

The United States Forest Service has issued Bulletin 84, entitled "Preservative Treatment of Poles." This is an extremely interesting publication of 55 pages that should appeal to all electrical companies using timber poles for overhead circuits. It gives the results of several years of investigation of the more inexpensive preservative methods that aim to treat only the lower part of the pole. Brush treatment is, of course, the simplest but at the same time not very effective method. The open-tank process has more merit; three different methods of carrying it out are described. Careful preliminary seasoning is needed in any case.

Detailed results of a large number of treatments of chestnut, southern white cedar, northern white cedar, western red cedar, western yellow pine and loblolly pine are given. Most of the treatments were with creosote oil, zinc chloride being also tried out, however. Several illustrations and many tables show the penetration attained, the latter giving also many valuable data regarding the tests.

The design and operation of pole-treating plants is taken up and the cost of various treatments given. Other topics considered are the increased life of treated poles, financial saving effected, relation of preservative treatment to pole specifications. The more important conclusions from the investigations discussed in this bulletin are:

Seasoning of poles reduces their weight, commonly from sixteen to thirteen per cent, and even more for some species, with a corresponding decrease in the cost of transportation. Thorough seasoning is essential if the poles are to be treated with preservatives. In general, poles cut during the spring and summer lose weight most rapidly. Poles cut during autumn and winter lose weight less rapidly, but more regularly. Too rapid seasoning may be detrimental to the timber by causing excessive checking. Shrinkage of poles during seasoning is very slight, and does not exceed one per cent on the circumference.

A simple and inexpensive way of using a preservative consists in applying it to the surface of the pole with a brush. Butt treatments made in this manner with a good preservative may be expected to add two to three years to the life of the poles and more than repay their cost, but are not as effective as impregnating the wood with the preservative.

Impregnation of many pole timbers, especially the sapwood of round timbers, may be successfully accomplished in open tanks, without the use of artificial pressure, by immersions in hot and cold preservative, the cold following the hot. The open-tank process for the treatment of poles has the advantage that it is possible to apply the preservative to the butts only, with a great saving in the amount used. Plants for butt treatments may be constructed in a simple and inexpensive manner.

Preservative treatment is profitable financially, the increased durability of the timber decreasing the annual service charge. Relatively greater benefits are derived from the treatment of nondurable woods than from the treatment of those which possess great natural durability. Preservative treatment makes possible the use of poles of smaller butt circumference, since allowances usually made for deterioration by decay need not be considered, when it is certain that the full size and strength of the poles will be retained through a long period of years. By the application of preservative treatment, many species of timber not naturally durable and formerly not considered suitable for poles may be used for this purpose, thus opening up new sources of supply, and greatly relieving the pole situation from the threatened exhaustion of those woods now most commonly used.

Trials of an Oerlikon 3,000-Kilowatt Turbo-Generator.

Last year the Oerlikon Company installed a 3,000-kilowatt turbo-generator in the stand-by central station of the Société Lyonnais des Forces Motrices du Rhone, at Cusset-Villeuxbanne, France, which was recently tested.

The turbine is designed for a steam pressure of fifteen atmospheres, a steam temperature of 350 degrees centigrade and a speed of 1,500 revolutions per minute. The generator was specified to give a normal continuous output of 3,000 kilowatts at a power-factor of 0.65, as also 3,500 kilowatts during two hours at the same power-factor. The excitation current is supplied by a separate exciting machine. The condensing plant is of the Paris Westinghouse Company's make, consisting of a surface condenser and the requisite rotary air, circulating and force pumps, all three

3000-KILOWATT OERLIKON STEAM TURBO-GENERATOR.

	Number of Test.			
	1.	2.	3.	4.
Duration of trial in minutes	120	120	120	40
Load in per cent	50	50	100	120
Revolutions per minute.	1510	1509	1506	1507
Steam pressure at the turbine in atmospheres	14.0	14.1	14.0	13.8
Temperature at inlet in degrees centigrade	347.9	351.7	350.3	349.5
Steam pressure in front of second set of nozzles in atmospheres	3.8	3.8	11.9	12.3
Temperature of exhaust steam measured at low-pressure end of turbine, in degrees centigrade	19.1	19.5	26.4	29.5
Vacuum in condenser in per cent absolute	97.83	97.80	97.5	97.1
Total steam consumption in pounds per hour	20,827	20,779	38,799	45,749
Three-phase energy in kilowatts	1555.5	1594.9	3165.6	3574.9
Power-factor	0.675	1.0	0.665	0.715
Steam consumption per kilowatt-hour at above power-factor, including condenser work, but excluding excitation, in pounds	13.37	13.02	12.25	12.80
Power consumption for excitation at power-factor unity, in kilowatts	18.48	18.57	21.12	22.83
Steam consumption per kilowatt-hour at power-factor unity, including excitation energy, but excluding condenser energy in pounds	12.38	12.32	11.62	12.19
Efficiency of generator	89.5	89.5	93.0	93.5
Steam consumption per brake horsepower	8.16	8.12	7.94	8.40

direct-coupled to a 72-brake-horsepower Oerlikon steam turbine. running at a speed of 1,500 revolutions per minute. The measured condensed steam includes the steam consumed by this machine.

The electrical measurements were made by means of calibrated precision wattmeters. The condensed steam was measured by means of calibrated tanks. The influence of the small condenser turbine is, of course, adverse to the over-all results, as naturally a 72-horsepower turbine running at 1,500 revolutions per minute works with a relatively small efficiency.

At test No. 1 the generator worked with a power-factor 0.675, and at test No. 2 on a water resistance. If the difference in the temperature interval is taken into account in comparing above two trial points, the steam consumption increase at power-factor 0.675 amounts to 2.2 per cent above that when running at power-factor unity. For the recalculation of the direct readings of test results, under 3 and 4, the steam values are assumed to be correct; though it is only natural that at greater loads the average influence of the lower power-factor is larger.

Careful measurements, which were made with the pump-turbine, showed that at full load, test No. 3, the turbine-driven condenser-pumps consume 3.3 per cent of the total steam; at half load, test Nos. 1 and 2, 6 per cent, and at overload, test No. 4, about 2.9 per cent of the total steam consumption values, which values are considered as rather low for turbine-driven pumps. The energy consumption of the excitation at non-inductive load was actually measured for trial No. 2, while those for the trials 1, 3, and 4 have been ascertained by calculation.

In order to obtain the steam consumption per brake horsepower, measured at the turbine shaft, the efficiency of the generator has to be inserted in the figures of the individual tests in accordance with values given in the table.

Commercial Practice—Management, Rates, New Business.

CONTRACTS FOR THE SUPPLY OF ELECTRIC POWER FROM THE MANUFACTURER'S POINT OF VIEW.[1]

BY H. E. M. KENSIT.

It is becoming daily more common for the manufacturer to cease operating his own power plant and to take a supply from an electric power company, under contract for a term of years.

The technical terms of such contracts are usually more fully thought out by the power company than by the manufacturer. The power company has a thorough grasp of the technical conditions and of the results to be expected from past experience in similar matters, which the manufacturer has not. The contract contains technical clauses, as distinct from legal clauses, which neither the manufacturer nor his legal adviser, however competent, can fully grasp in all their bearings.

Most contracts for any considerable amount of electric power now contain a clause that the power-factor of the load must be kept within certain defined limits or an extra charge will be made, and there is probably no other one clause which, when enforced, has led to more misunderstanding and dissatisfaction.

The following are samples of these clauses:

(1) "When the power-factor of the greatest amount of power taken for said twenty minutes falls below 90 per cent the corporation shall pay for 90 per cent of the said power divided by the power-factor." (Hydro Electric Power Commission of Ontario.)

Here the reference to "twenty minutes" means that the charge will not be based on a peak load lasting less than twenty consecutive minutes at any one time.

To interpret the extra charge due to the power-factor, suppose that 100 horsepower is taken and that the power-factor turns out to be only 80 per cent. Then 90 per cent of 100 horsepower is 90 horsepower. Ninety horsepower divided by 0.80 = 112.5, so that the customer will have to pay for 112.5 horsepower.

(2) "The city . . . . . agrees to pay for the energy on the basis of at least an average 90-per-cent power-factor, and should the energy be found to be delivered at less than an average 90-per-cent power-factor, the basis of payment shall be adjusted by increasing the payment calculated as above, so as to make it correspond to a delivery of power on a basis of 90 per cent power-factor."

If we take the phrase "make it correspond" to mean proportionately, then if the apparent power was 100 horsepower and the power factor proved to be 80 per cent the power to be paid for would be 112.5 horsepower, as in the previous instance.

(3) "The intent of this contract is that the Cement Company shall arrange its equipment so that the power-factor shall be about 90 per cent and that the measurement shall be so made that the Cement Company shall pay for the true and not the apparent energy."

This is not very clearly expressed, but the intention is the same as in the previous instances.

To arrive at a clear understanding of this matter we should consider three points:

(1) What is the power-factor of a supply of electric power, and why does it affect the cost of power?

(2) What power-factor can usually be obtained under ordinary conditions, and what will any variation amount to in dollars and cents?

(3) If the power-factor is not as good as it should be, what can be done to improve it?

The "idle" or wattless current has to be reckoned with on account of its heating effect, and if it exists, and to the proportion to which it does exist, the power company has to increase the size of its generators, transformers and transmission lines in order to carry it, and thereby increase its capital expenditure proportionately.

Since the idle current, or, say, the power-factor, is caused by the customer's load, and since it is to a great extent within his control and not at all within control of the power company, it is but just that the customer should be required to keep it within reasonable limits.

As to the second of our three points, the following table shows the efficiencies and power-factors that may be expected from polyphase motors of first-class design and make; if not first-

Size in Horse-power.	Efficiency Per Cent. Half Load.	¾.	Full.	Power-Factor Per Cent. Starting.	Half Load.	¾.	Full.	Starting Current in Terms of Full Load Current.
5	79	82	82	60	76	84	88	2.25 to 2.75
10	81	83	83	60	80	87	90	"
20	83	84	84	60	81	88	91	"
50	85	86	86	60	81	88	91	"
75	86	87	87	65	83	89	92	"
100	88	89	89	65	85	91	92	"
Avge.	84	85	85		81	88	91	

1 Abstracted from *The Canadian Engineer.*

class, or if single-phase, both efficiencies and power-factors may be considerably lower.

In designating alternating-current transmission systems the generally accepted allowances made for the power-factor of the load are as follows:

Lighting load only.....95 per cent
Mixed load, chiefly lighting 90 per cent
Mixed load, chiefly motors..85 per cent
Motor load, ordinary.....80 per cent
Motor load, if very intermittent and irregular..75 per cent

These naturally allow for the worst conditions ordinarily met with, but even worse conditions do sometimes exist where the load is irregular and the motors too large for the work or of poor design, average power-factors as low as 70 per cent, or even 65 per cent being sometimes met with in mining work, steel rolling mills and similar intermittent loads.

A consideration of the above figures will show that where the amount charged for power is to vary in proportion to the power-factor, this power-factor becomes a very important matter.

While an individual motor working at full load may have a power factor of 90 per cent or a little more, a number of motors on more or less intermittent and irregular work do not usually give a resultant power factor of more than 80 per cent and may only give 70 per cent or even less.

Right here is where the manufacturer or power user not infrequently gets let in for what he does not fully expect or realize. Usually he has no clear idea of what his power-factor is likely to be and thinks he is getting a ten-per cent-margin anyway. The power company, on the other hand, knows perfectly well that the power-factor of a load consisting entirely or mainly of motors will not reach 90 per cent, and that there will consequently be an extra payment required on the score of low power-factor.

It is usual, as shown in the sample clauses given above, to name 90 per cent as the normal power-factor, but it would appear fairer in the case of contracts for motor loads to name a higher price and a power-factor that there is some probability of being able to obtain in practice.

As to the difference in annual cost that may be caused by a power-factor lower than the 90 per cent specified in the agreement, suppose the case of a steel rolling mill using 500 horsepower, paying $25 per horsepower-year for power, and having an average power-factor of 75 per cent.

$500 \times \$25 = \$12{,}500$.

$\$12{,}500 \times 90/75 = \$15{,}000$. The extra cost per annum is $2,500 or 20 per cent.

Now it is perfectly legitimate and proper that the power company should be paid extra for a load involving a power-factor which is lower than that covered by their ordinary rates, but it ought to be clearly understood in such cases what the power-factor and consequent extra charge to the customer is likely to be.

As to the third of the three points to be discussed, low average power-factor in connection with an ordinary polyphase-motor load, assuming the motors to be of good make and design, is mainly due to frequent stopping and starting, and to working the motors at less than full load. It is greatly aggravated by using motors too large for their work, so that even when the tool is fully loaded the motor is underloaded.

If the motors are large for the work and the work is intermittent or variable, the average power-factor may easily be that due to an average of half load. Referring to the table of power-factors, it will be seen that the average power-factor of motors from 5 to 100 horsepower is 91 per cent at full load and 81 per cent at half load, a difference of 10 per cent. In practice, when some of the motors are being constantly stopped and started, or varying between small load and full load, the difference may be considerably greater.

Much may therefore be done to improve the power-factor by having the motors properly proportioned to their work and, as far as possible, avoiding starting several motors at the same time, or allowing them to run light. As good modern polyphase motors have an overload capacity of at least 50 per cent for half an hour, and much greater momentary overload capacities, there is seldom any necessity to put in motors rated above the output of the tool, and in many cases of intermittent load the motors may safely be of less rated horsepower than that of the tool.

If a low power-factor has to be paid for, it is well worth while to take careful measurements of the power required by each tool and to re-arrange the motors and drives accordingly.

If these measures are not sufficient to secure a power-factor reasonably close to the 90 per cent specified, this result can always be secured, where there are a number of ordinary induction motors installed, by substituting for one of these a separately excited synchronous motor of slightly larger capacity than required for driving its load and adjusting the excitation until the desired power-factor is secured. This will affect the power-factor of the entire load or works. It is not usually desirable or economical to endeavor to bring the power-factor of a motor load above 90 per cent. This is a matter in which the advice of a competent electrical engineer would have to be taken as to the choice of a motor to suit the conditions in the particular factory under consideration, but it is not an expensive matter, and the saving in the first year would in many cases, more than repay the entire cost.

Seattle Lighting Rates Reduced.

With the completion of the new hydroelectric power plant of the Pacific Coast Power Company, at Derringer, on Lake Tapps, about five miles from Auburn, Wash., the Seattle Electric Company, which has contracted for the power to be generated for distribution at Seattle, has reduced its electric lighting rates in the city proper about twenty-five per cent. The new schedule is as follows: First sixty kilowatt-hours, seven cents; all over sixty kilowatt-hours, four cents. Minimum monthly charge, $1.00. These rates are similar to those now being charged by the municipal lighting plant, and are net.

The former rate, on which a ten-per-cent discount was allowed for early payment, was 9.5 cents, 8.5 cents, and 7.5 cents, for each respective twenty kilowatt-hours up to sixty kilowatt-hours, and five cents per kilowatt-hour for anything thereover. The monthly minimum was $1.10.

With the power to be derived from this new plant, and its hydroelectric generating station at Electron, the company plans to close down its steam plant at Georgetown, and to use its steam generating station on Post Street, Seattle, only as emergency.

As compiled by the United States Geological Survey, the coal production in the State of Kansas in 1910 was 4,921,451 short tons valued at $7,921,451.

Electric Lighting and Illuminating Engineering

LUMINOUS INTENSITY AND ENERGY RELATIONS IN INCANDESCENT LAMPS.

BY F. E. CADY.

In a paper presented before the Illuminating Engineering Society[1] it was shown that an equation of the type $I=aV^k$, where I is the luminous intensity or candlepower and V is the voltage, does not adequately represent the relation between candlepower and voltage of an electric incandescent lamp, if both k and a are assumed to be constants. Though it had previously been recognized that k was different for lamps of different filament material, it was shown in the previous paper that for lamps of the same filament material, k, though very closely the same when the lamps are operating at the same efficiency, is a variable and a function of the efficiency.

That the exponent k in the equation as given above might be expected to be a variable follows from theoretical considerations. For, if k were a constant, then differentiation and division would give $k = dI/I \div dV/V$. Now in the case of a black body it can readily be shown that the ratio of the percentage change in luminous intensity to the percentage change in power input varies from very large to very small values in passing from low to high temperatures. It has been shown by various observers that incandescent lamp filaments follow laws similar to those of a black body. Under these circumstances it can be shown that the ratio $dI/I \div dW/W$ changes in the same manner as above indicated for a black body. Since wattage changes are caused by changes in voltage it follows that k as defined above cannot in general be constant. The experimental data of this and the previous work are consistent with this conclusion.

It should be emphasized that k as used in this paper is defined by the equation $k=dI/I \div dV/V$ without reference to the equation $I = aV^k$. But it was shown in the previous paper that the latter equation can be used between two voltages if for k is used the average value of k as defined by the former equation and taken from the k-voltage curve.

Since the presentation of the paper referred to, a considerable amount of data has been published bearing on this subject. Remane[2] gives data on candlepower of tungsten lamps at voltages above normal, from which corresponding k's may be computed.

Bohle[3] gives the following equations:

For carbon, $I = 5.08 \times 10^{-16} V^7$

For tantalum, $I = 0.11 \times 10^{-7} V^{4.4}$

For tungsten, $I = 0.16 \times 10^{-6} V^{4.0}$

Blondel[4] gives the following table (with the exception of the last two columns) of values of k, for different types, obtained by various observers:

Filament	Hirschauer	Morris	Sharp	Laboratoire Central	Bohle	Laporte	Cady
Ordinary Carbon	6.3		6.5	6.0	7	5.8 to 6.5	5.4
Tantalum	4.3	4.37 to 4.70	4.4	3.9	4.4	3.9 to 4.3	4.0
Tungsten	4.0	3.36 to 3.65	4.0	3.8	4.0	3.6 to 3.8	3.6

For purposes of comparison the values found by Laporte[5] and those corresponding to normal specific consumption given in the previous paper referred to[6] have been added. T. H. Amrine and A. Guell[7] give $I = 213.7 \times 10^{-8} V^{3.44}$ for the tungsten lamp. From the candlepower-voltage data given by K. Satori[8] k may be computed for carbon and tungsten, giving 6.0 for the former and 3.35 for the latter.

Berninger[9] measured new lamps and found for 10, 16, 25 and 32-candlepower carbon lamps values of k ranging from 6.1 to 6.94, while he gets 4.05 for tungsten lamps.

Jolley[10] finds two equations for carbon lamps as follows, where 100 is normal voltage:

$I=3.2 \times 10^{-10} V^{5.4}$ for values of V above 85 volts.

$I=1.26 \times 10^{-12} V^{7.2}$ for values of V below 85 volts.

For tantalum lamps he gives

$$I=1.59 \times 10^{-7} V^{4.09}.$$

For tungsten lamps he gives

$$I = 4.79 \times 10^{-7} V^{3.92}.$$

Elden[11] gives data on carbon lamps from which the k's corresponding to various voltages may be computed. For normal voltage $k = 5.51$.

In a paper by Howell[12] a candlepower-voltage curve for the tungsten lamp is given and in the discussion on this paper by Merrill, Cooper and Blake the following values of k are given: for carbon lamps, 5.55; for tantalum lamps, 4.20; for tungsten lamps, 3.68.

Pecheux[13] gives for new ordinary carbon lamps two equations, the first for a 16-bougie-decimale, 130-volt lamp, the second for a 20-bougie-decimale, 270-volt lamp, as follows:

$I = 3.36 \times 10^{-12} V^{5.97}$ for the 130-volt lamp.

$I = 2.02 \times 10^{-24} V^{10.28}$ for the 270-volt lamp.

For two new tantalum lamps he has $k = 2.27$ and $k = 3.88$.

For eight new tungsten lamps of various normal intensities at approximately 130 volts his values of k range from $k = 3.02$ to $k = 4.18$.

M. Tappley[14] gives the following values of k corresponding to voltages normal and twenty per cent below normal.

	Normal.	20 per-cent below normal.
Ordinary carbon	6.0	7 to 8
Tantalum	3.5 to 4.0	4 to 4.5
Tungsten	3.5 to 4.0	3.5 to 4.0

From curves by Schroeder[15] showing the relation between candlepower and voltage, k at normal voltage may be computed and is found to be approximately 5.35 for carbon and 3.8 for tungsten lamps.

It would seem from a consideration of these published data that there is as yet

1 Transactions Illuminating Engineering Society, 3, 1908; page 459.

2 R. Remane, *Elektrotechnische Zeitschrift*, 29, 1908; page 853.

3 H. Bohle, *Illuminating Engineer* (London), 1, 1908; page 735.

4 A. Blondel, *Bulletin Societe Internationale des Electriciens* (2), 9, 1909; page 79.

5 F. Laporte; *ibid*, page 111.

6 *loc. cit.*

7 *Bulletin* No. 33, Experiment Station, University of Ill.

8 K. Satori, *Elektrotechnik und Maschinenbau*, 27, 1909; page 227.

9 Al. Berninger, *Elektrotechnik und Maschinenbau*, 27, 1909; page 607.

10 A. C. Jolley, *Electrician*, 63, 1909; page 700.

11 L. L. Elden, *Bulletin National Electric Light Association*, 3, April, 1910; page 360.

12 J. W. Howell, *Transactions American Institute of Electrical Engineers*, 29, 1910; page 938, and discussions, page 959.

13 H. Pecheux, *La Lumiere Electrique* (2), 14, 1911, page 365.

14 M. Tappley, *Electrical Review* (London), 69, 1911; page 157.

15 H. Schroeder, *General Electric Review*, 14, 1911; page 426.

Note—Since the publication of the previous paper, the writer's attention has been called to some early work on this subject presented to the American Institute of Electrical Engineers by W. D. Weaver.

no definite agreement on the part of different observers in the value of k corresponding to normal voltage either for a single type of filament such as carbon, or for the various types including Gem, tantalum and tungsten. These discrepancies may be due to a number of causes. Chief of these is the personal element which enters into the photometric work as soon as color differences are encountered. It is the old problem of heterochromatic photometry. Just how much this difficulty affects results is at present somewhat conjectural. Another very probable cause lies in the method of determining k. In most cases k is determined from the curve showing the relation between candlepower and voltage. If, in the equation $I=aV^k$, where I is the luminous intensity and V the voltage, the method of least squares is used to determine the best values of a and k to make the equation fit the curve, the value of k will depend upon the range of voltage and to what part of the curve this range belongs.

On the other hand if k is determined by taking candlepower measurements at two voltages differing by only one or two per cent, the very highest photometric accuracy must be obtained to get results approximately correct. If the range of voltage is made greater, say eight or ten per cent, in order to minimize this difficulty, the question arises as to whether the k obtained has been assigned to the initial or final voltage or to a voltage midway between. In the case of the treated carbon at normal voltage, k varies by five or six per cent with a ten-per-cent variation in voltage. Again, in the case of the treated-carbon lamp, k may be slightly different, as will be shown later, for lamps of different manufacture, owing to differences in the chemical constitution or thickness of deposit.

The previous data submitted by the writer were taken from some tests made for another purpose, and while made with great care, these tests were not as complete in number and scope as might be desired for the determination of k. It was, therefore, felt that some additional data, made with this end in view on lamps manufactured at the present time, would be of value in verifying previous work, filling out gaps, and showing differences, if any, between lamps of the same filament material as manufactured then and now.

Method Used.—The method of making the tests in this investigation was the same as that outlined in the previous paper. The apparatus employed consisted of a precision photometer bench with a Lummer and Brodhun contrast photometer and a potentiometer with its customary adjuncts for controlling the voltage and determining the current value. The comparison lamp was a special tungsten lamp having spring upper supports so that there were no variable contacts.

All the lamps investigated were first measured for mean horizontal candlepower at voltages giving the same color as the carbon lamps used as standards. Check measurements were made on each lamp, and the average taken as a basis for computing its mean spherical candlepower. The latter was determined by using the ordinary reduction factors.

A series of groups of measurements were then taken, each group consisting of five sets of readings, the first, third and fifth sets at the higher and the second and fourth at the lower of the two voltages used. During the measurements on one group the comparison lamp was set at a voltage to give a color match with the test lamp when the latter was at a voltage midway between the two used in the measurements. The two voltages used for the test lamp were so chosen that the resulting candlepower change was in the neighborhood of thirty per cent. The intervals between groups were made small enough to give sufficient points to plot a curve. To cut off sources of error as far as possible, a sector disk was used at the higher voltage, bringing the reading to about the same point on the scale as the reading for the lower voltage. Accurate current measurements were made at each voltage.

The principal advantage in the above method of operation lies in the fact that it is necessary to make observations at only a few points in order to get the k-voltage curve, from which the candlepower-voltage curve may be computed. If the latter is obtained by the point-to-point method, a large number of observations must be made in order to reduce the uncertainty due to color difference to a minimum.

Sources of Error.—In measurements of this character there are a number of sources of error which should be considered. First, in the photometric measurements themselves there is the uncertainty in the determination of the point of photometric balance. If the candlepower change is small, say ten per cent, an uncertainty of one per cent at either upper or lower voltage would produce an uncertainty in the exponent k of approximately ten per cent. It is therefore evident that the candlepower change should be made as large as possible. On the other hand, a big candlepower change means a big color difference which, though the magnitude of the error is not known, is equally undesirable. With a thirty-per-cent candlepower change, no difficulty, due to the color difference, was experienced in making settings. Another source of uncertainty lies in changes in the test lamp due to aging. The lamps were measured just as they came from the makers, and particularly in the case of the carbon and tantalum lamps, at voltages above normal, there was an appreciable change in candlepower during a set. The lamps were not given a preliminary aging because it was felt that data of this character is generally most useful in connection with new lamps. The method of making the measurements, however, largely eliminates the uncertainty due to these aging changes provided the latter are uniform during a group measurement. It should be noted that this uncertainty affects only that portion of the k-voltage curve above the normal voltage and is greatest at the part of the curve least used.

A more serious difficulty in the case of the tantalum and drawn-wire tungstens is the constant changing of the contacts between the filament and the supporting loops. This causes an intermittent fluctuation both in luminous intensity and wattage. It can be allowed for only by taking a sufficient number of sets in a group to give a good average. This difficulty in obtaining consistent measurements on tantalum and tungsten lamps may possibly account in part for the discrepancies in the published values of the exponents for these types.

Lamps.—The carbon lamps used in this investigation were obtained from two manufacturers and designated Brands E and W. They were ordinary, treated, 50-watt, 115-volt (top voltage) anchored, oval lamps. A complete series was made on four from each manufacturer, and a single group on two more.

The tantalum lamps, of which there were four, were 40-watt, 115-volt (top voltage) lamps. The four tungstens from which the values of k were derived, were 40-watt, 115-volt (top volt-

age) pressed-wire lamps, with special spring supports avoiding contact fluctuations. In addition, group determinations at one or two points were made on two 25-watt and four 60-watt drawn-wire tungstens, all 115-volt (top voltage) lamps, and on two tantalum lamps similar to the others. The tantalum lamps were obtained from one manufacturer, the pressed-wire tungsten lamps from another and the drawn-wire tungsten lamps from still another. All the lamps had clear-glass bulbs.

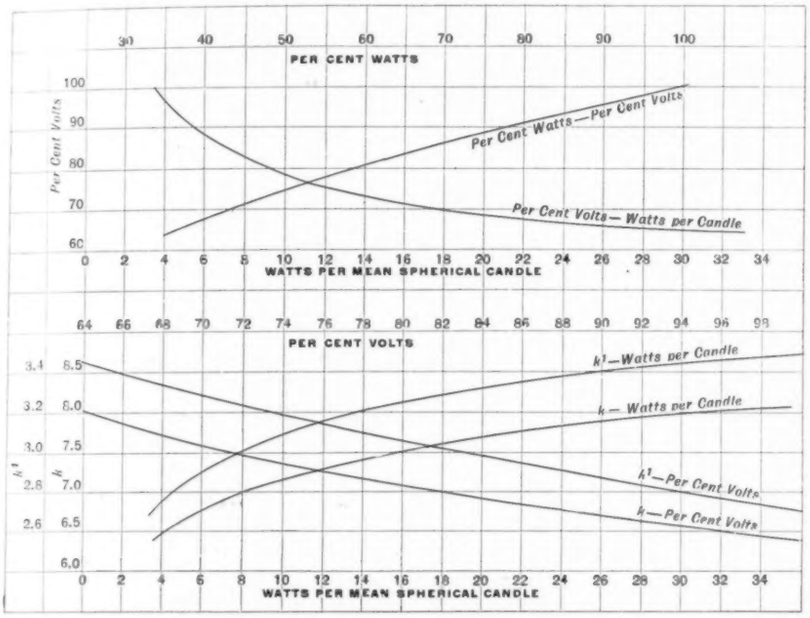


FIG. 1.—UNTREATED CARBON FILAMENT.

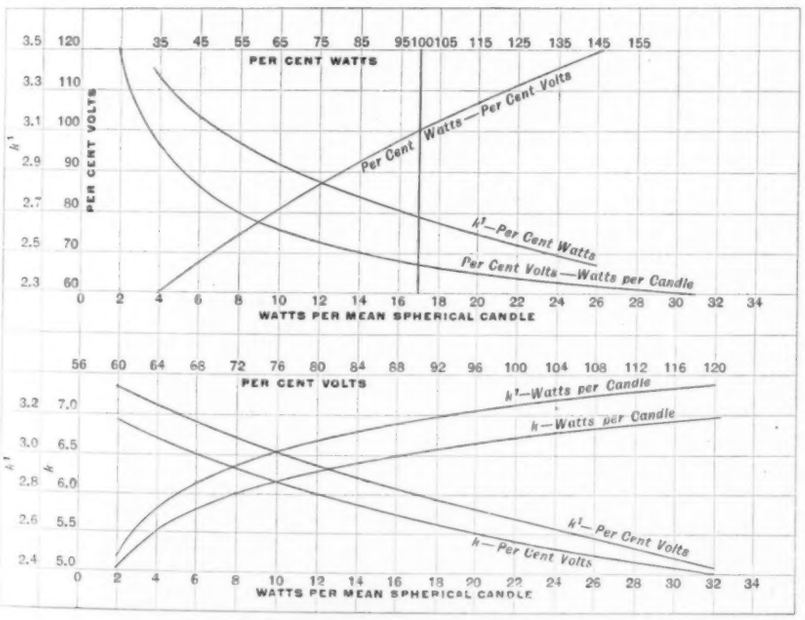


FIG. 2.—TREATED CARBON FILAMENT.

Data.—The data obtained in the previous investigation have been plotted in the form of curves as shown in Figs. 1 to 6. Each set of curves refers to one type of lamp and shows the relation obtained between (1) per-cent voltage and per-cent wattage; (2) per-cent voltage and watts per mean spherical candle; (3) per-cent voltage and exponents k and k'; (4) watts per mean spherical candle and k and k'; and (5) in the case of treated carbon, per-cent wattage and k'; k' being the exponent in the equation $k' = dI/I \div dW/W$, where I is the intensity and W is the wattage.

With the exception of the watts per mean spherical candle, for purposes of comparison all the data have been expressed in per cent, 100 per cent corresponding to that voltage or wattage at which the lamps have a specific consumption of 3.5 watts per mean spherical candle. As the present data are more or less confirmatory in character, differences between the old and new data will be shown by tables.

As previously mentioned, the exponent k derived from candlepower measurements made at two voltages not too far apart, using the formula $I/I_0 = (V/V_0)^k$ is equivalent to the average value of k derived by integration of the k-voltage curve between the two voltages in question. It can be shown by analysis that this value of k can be assigned to the mean of the two voltages provided the range in voltage is not too great, say ten per cent. If this is done, then one can draw the curve showing the relation between k and voltage. Conversely, if it is desired to obtain the candlepower at one voltage in terms of the candlepower at another, it is permissible to use the above equation and take for k the value corresponding to the middle voltage if the range is small, or if large, to use the average value of k between the voltages used. This average value may be obtained by integration of the equation of the curve between the points. It should be emphasized that in the present work, for purposes of comparison or in the computation of candlepower, the value of k taken from the k-voltage curve, corresponding to a given value of voltage, say V_1, is the k holding over a small range of voltage, say eight or ten per cent, of which V_1 is the middle point. Or, to put it another way, if the intensity I_0 at a voltage V_0 is known, and it is desired to obtain the intensity I_1 at a voltage V_1, the value of k to be used is not the k in the k-voltage curve corresponding to V_1, or to V_0, but the average of the values of k in the interval between V_1 and V_0; and if V_1 and V_0 do not differ by more than about ten per cent the value of k on the curve corresponding to a voltage $(V_1+V_0)/2$ may be used. The work of computing candlepower values is very much simplified if ten-per-cent voltage intervals are used and the candlepower at each voltage is computed from the value at the preceding voltage, using the k corresponding to the voltage midway between. Such computations are enormously simplified

by the use of a double-logarithm slide-rule.

In the case of treated-carbon lamps it might be expected that there would be some discrepancies in the values of k corresponding to a given efficiency, since the resistance temperature-coefficient is a function of the treatment. It was found that the k-voltage curves for the two brands of carbon lamps were different by a fairly constant amount. This is shown in Table I. In the second column are the values of k previously obtained. The lamps from which the former data given in column two were derived were obtained in part from the same source as brand E.

TABLE I.
VALUES OF k AT VARIOUS VOLTAGES FOR TREATED-CARBON LAMPS.
100 Per Cent is the Voltage Corresponding to 3.5 Watts per Mean Spherical Candle.

Per-cent voltage.	k Former.	k Brand E.	k Brand W.
55	7.29	7.32	7.62
60	6.94	7.00	7.25
70	6.40	6.46	6.64
80	6.00	6.02	6.19
90	5.68	5.69	5.81
100	5.40	5.41	5.57
110	5.16	5.17	5.30
120	4.97	4.94	5.05
125	....	4.83	4.95

It would appear from an examination of this table that there is a consistent difference in k, between brand E and brand W lamps, of about three or four per cent. This can easily be accounted for, as stated before, by differences in treatment when the filaments are flashed. It might be added that this difference is somewhat less than the range of the individual lamps of one brand. A difference in the watt-volt curves of the two brands indicates that the above explanation is at least in part correct.

It is evident, therefore, that in the case of carbon lamps, the k-voltage curve cannot be used as a basis for estimation of the behavior of new lamps. For this purpose it is better to use the k'-wattage curve, which takes into account the resistance-temperature changes. In this case no consistent difference was found between the E lamps and the W lamps. Table II gives a comparison between the former and the new values.

TABLE II.
VALUES OF k' AND PER-CENT WATTAGE FOR TREATED-CARBON LAMPS.
100 Per Cent is the Wattage Corresponding to 3.1 Watts per Mean Horizontal Candle.

Per cent of normal wattage.	k' Former.	k' New.
40	3.27	3.36
50	3.13	3.19
60	3.01	3.06
70	2.92	2.95
80	2.84	2.86
90	2.77	2.78
100	2.71	2.71
110	2.65	2.65
120	2.59	2.60
130	2.54	2.56
140	2.49	2.52
150	....	2.50
160	....	2.47

The fact that there are differences even in this case between the old and new values of k' may mean, and particularly at low voltages, that such factors as the energy losses at the leading-in and anchoring wires, variations in the character of the radiating surfaces, slight differences in the reduction factors and so forth, affect the results.

In Table III the candlepower values computed from the new data are given. This computation was based on the k'-wattage curve. The values given in the column headed "Per cent of normal voltage" are the averages of the values of the E brand and W brand corresponding to a given per-cent wattage.

Table IV gives data obtained with the tantalum lamps, including a comparison with former values.

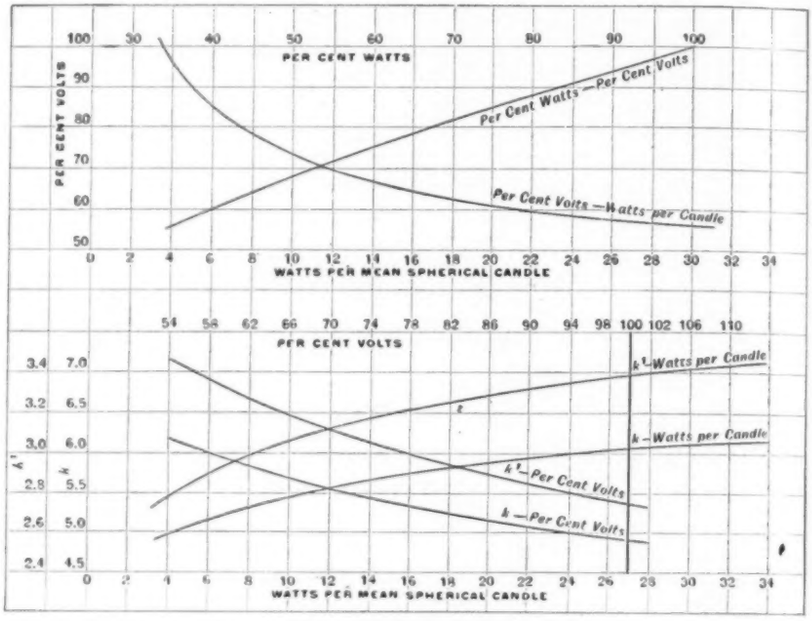

PER CENT WATTS
PER CENT VOLTS
Per Cent Watts — Per Cent Volts
Per Cent Volts — Watts per Candle
WATTS PER MEAN SPHERICAL CANDLE
PER CENT VOLTS
k' Watts per Candle
k — Watts per Candle
k' — Per Cent Volts
k — Per Cent Volts
WATTS PER MEAN SPHERICAL CANDLE

FIG. 3.—GEM FILAMENT.

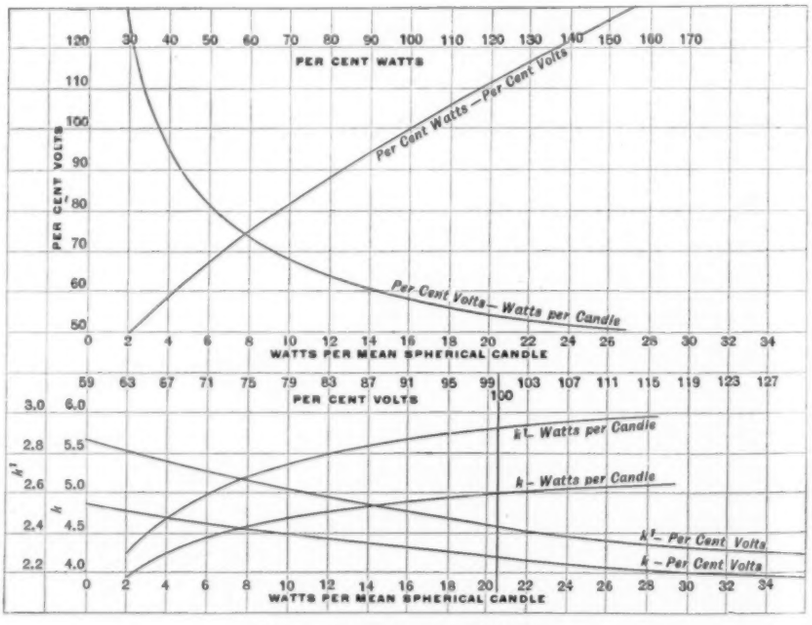

PER CENT WATTS
PER CENT VOLTS
Per Cent Watts — Per Cent Volts
Per Cent Volts — Watts per Candle
WATTS PER MEAN SPHERICAL CANDLE
PER CENT VOLTS
k' Watts per Candle
k — Watts per Candle
k' — Per Cent Volts
k — Per Cent Volts
WATTS PER MEAN SPHERICAL CANDLE

FIG. 4.—TANTALUM FILAMENT.

Similar data for tungsten lamps is given in Table V.

With the exception noted, the differences between the former and new values of k for both the tantalum and tungsten lamps are small, being only about one per cent, which is less than the un-

certainty due to experimental error. The data on the drawn-wire tungsten lamps differed from that on the pressed-wire lamps by an amount less than the experimental uncertainty.

It would therefore seem, in the case of the metal-filament lamps, that $k=$ $dI/I \div dV/V$ is a function of the efficiency; that, at a given efficiency, it has the same value to within negligible error for all lamps of the same kind of filament, but that it has different values for lamps of different filament material.

Since k as defined above is a variable and a function of the efficiency, it follows that if the equation $I/I_0=(V/V_0)^k$ is used to compute candlepower values, and k is assumed to be a constant, the error in a computed candlepower will depend upon the value of k used and the range of voltage involved. As previously stated, a value of candlepower I_1 corresponding to a value of voltage V_1 can be derived from the value I_0 at a voltage V_0 provided the k used is the one corresponding to the voltage midway between V_1 and V_0 when the interval V_1—V_0 is not too great.

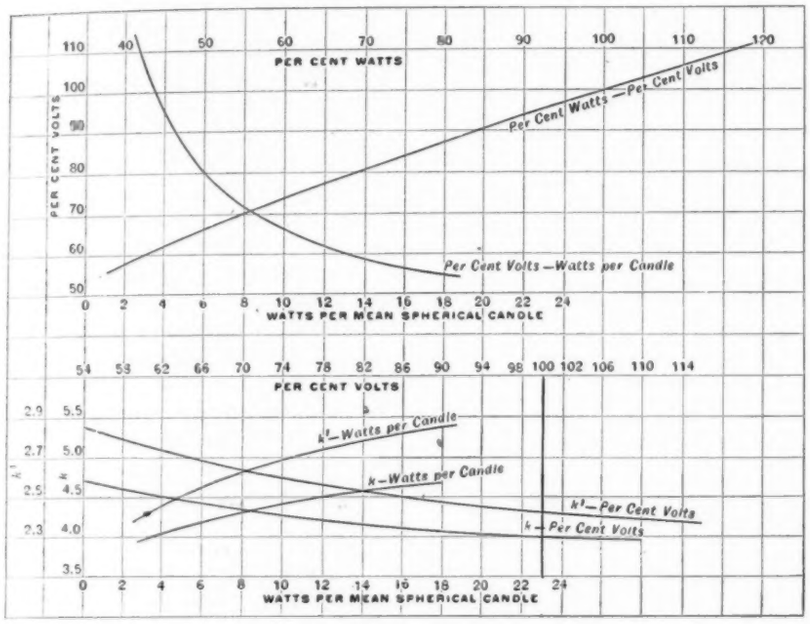


FIG. 5.—OSMIUM FILAMENT.

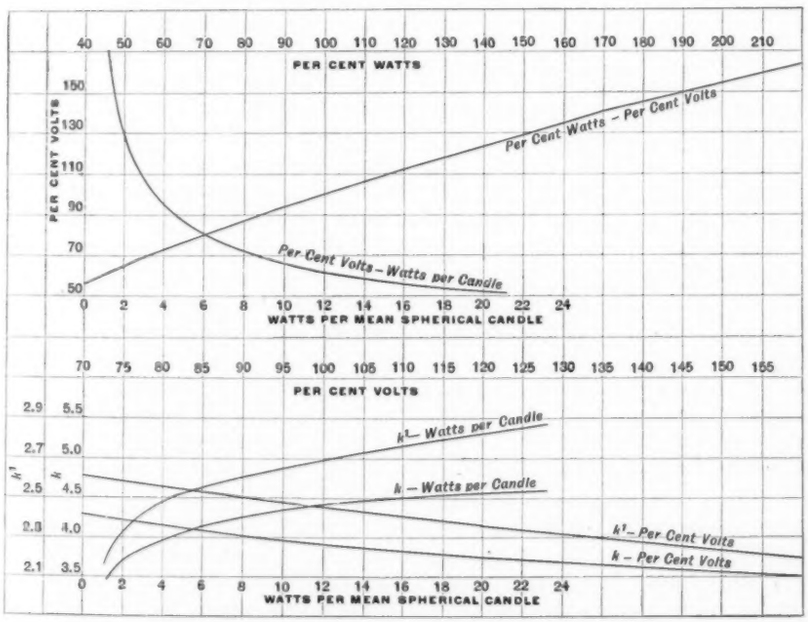


FIG. 6.—TUNGSTEN FILAMENT.

TABLE III.

VALUES OF CANDLEPOWER AND VOLTAGE FOR TREATED-CARBON LAMPS.

Corresponding to Various Wattage Values. (100 per cent is Wattage Corresponding to 3.1 Watts per Mean Horizontal Candle.)

Per cent of normal wattage.	Per cent of normal candlepower.	Per cent of normal voltage.
45	9.2	67.6
50	13.2	71.2
60	23.0	77.8
70	36.5	84.1
80	53.7	89.8
90	74.9	95.2
100	100.0	100.0
110	129	104.8
120	162	109.2
130	199.5	113.5
140	241	117.8
150	286	122.0
165	362.5	128.3

TABLE IV.

RELATION BETWEEN VOLTAGE, WATTAGE, CANDLEPOWER AND k OF TANTALUM LAMPS.

100 Per cent is Voltage Corresponding to two Watts per Mean Horizontal Candle.

Per cent of normal voltage.	Per cent of normal watt-age.	Per cent of normal candlepower.	k Former.	k New.
60	41.6	11.0	4.66	4.68
70	54.2	22.3	4.46	4.46
80	68.0	39.9	4.30	4.27
85	75.4	51.5	4.22	4.19
90	83.4	65.3	4.14	4.11
95	91.6	81.4	4.07	4.04
100	100.0	100.0	4.02	3.98
105	109.1	121.3	3.98	3.91
110	118.4	145.4	3.94	3.85
115	128.1	172.3	3.91	3.79
120	137.9	202.3	3.89	3.74
130	158.3	271.7	....	3.63

NOTE.—The differences between the former and new values of k at the higher voltage is due to uncertainty in the former data at these points.

TABLE V.

RELATION BETWEEN VOLTAGE, WATTAGE, CANDLEPOWER AND k OF TUNGSTEN LAMPS.

100 Per Cent Is Voltage Corresponding to 1.25 Watts per Mean Horizontal Candle.

Per-cent of normal voltage.	Per cent of normal watt-age.	Per-cent of normal candlepower.	k Former.	k New.
60	44.2	14.3	4.06	4.06
70	56.6	26.4	3.91	3.90
80	70.0	44.1	3.79	3.77
85	77.3	55.4	3.74	3.71
90	84.6	68.4	3.69	3.66
95	92.0	83.2	3.64	3.60
100	100.0	100.0	3.59	3.56
105	108.0	118.8	3.54	3.51
110	116.1	139.8	3.49	3.46
115	124.6	163.0		3.42
120	133.4	188.4		3.39
130	151.5	246.4		3.32
140	170.6	314.3		3.25

If the value of k used is approximately 5.5 and is in error by one per cent, and the range of voltage is ten per cent, the computed candlepower will be in error by approximately 0.5 per cent for a rise or 0.7 per cent for a drop in voltage. Reference to the preceding tables shows that over a range of voltage of five-per-cent decrease from normal, k changes in the case of carbon by 2.5 per cent, in the case of tantalum by 1.6 per cent, and in the case of tungsten by 1.3 per cent. If therefore the value of k at normal voltage were used to calculate the candlepower at a ten-per-cent decrease in voltage, the calculated candlepower would be in error by 1.7 per cent, 0.9 per cent and 0.7 per cent, respectively, in the three cases. These errors are somewhat lessened if the calculations are based on an increase instead of a decrease in voltage.

Equations.—As indicated in the intro-

duction, numerous equations have been given in the past for the relation between the luminous intensity and the voltage or wattage. In most cases these have been worked out for specific lamps and are not general in their application. The form $I/I_0=(V/V_0)^k$ is very convenient and the addition of a correction term will allow for the variation in k. Thus we may use, as an approximation,

$$\frac{I}{I_0}=\left(\frac{V}{V_0}\right)^k\left[1+B\frac{V-V_0}{V_0}+C\left(\frac{V-V_0}{V_0}\right)^2\right]$$

where I_0 is the candlepower at normal voltage V_0, and k_0 is the value of k at this voltage, *i. e.*, k_0 is the ratio of the percentage increase in candlepower to the percentage increase in voltage when this increase is infinitesimal and the lamp is operating at normal efficiency. B and C are constants which are general for tantalum and tungsten, but not for carbon lamps. The following are the equations for treated-carbon, tantalum and tungsten lamps.

$$\frac{I}{I_0}=\left(\frac{V}{V_0}\right)^{5.4}\left[1+0.05\frac{V-V_0}{V_0}-1.2\left(\frac{V-V_0}{V_0}\right)^2\right]$$

$$\frac{I}{I_0}=\left(\frac{V}{V_0}\right)^{3.98}\left[1+0.024\frac{V-V_0}{V_0}-0.65\left(\frac{V-V_0}{V_0}\right)^2\right]$$

$$\frac{I}{I_0}=\left(\frac{V}{V_0}\right)^{3.56}\left[1+0.02\frac{V-V_0}{V_0}-0.5\left(\frac{V-V_0}{V_0}\right)^2\right]$$

The above equation for treated carbon is typical only, since as already pointed out, the candlepower-voltage relation is unreliable in indicating the properties of unmeasured lamps. For the tantalum and tungsten lamps, however, these equations are perfectly general and give values agreeing (to less than one per cent) with those calculated from the data over a range of voltage thirty per cent above and below normal. It is believed that these equations can be used very satisfactorily to predict the behavior of new lamps, irrespective of differences in manufacture, or in the case of tungsten, whether they are of the pressed or drawn-wire type. With the equations in this form, the errors involved in the assumption of k as constant can be readily computed.

While the candlepower-voltage relation is the simplest to use in practice, the candlepower-wattage relation, since it indirectly takes into account the resistance, is perhaps more scientific. From a consideration of the laws of radiation, Féry and Chéneveau[16] assumed an equation for this relation of the type

$$I=A\,e^{-BW^{-c}}$$

where A, B and c are constants, and e is the base of the Napierian logarithms. The numerical values given in the equations, however, are not general, but refer to specific lamps. An equation which is general and of the same form may be readily deduced from the above. It is

$$I=I_0\,e^{B[1-(W_0/W)^c]}$$

where I_0 and W_0 are values corresponding to normal voltage.

Following are the equations for treated carbon, tantalum and tungsten.

For carbon,

$$I=I_0\,e^{12.14[1-(W_0/W)^{-5.43}]}$$

For tantalum,

$$I=I_0\,e^{11.45[1-(W_0/W)^{-5}]}$$

For tungsten,

$$I=I_0\,e^{16.48[1-(W_0/W)^{-7.92}]}$$

It should be noted, as pointed out by Ives[17], that in this type of equation the value of c can be varied over quite wide limits without affecting the agreement between the values computed from the equation and the given data.

Conclusions.—The results of the present work confirm the conclusions of the previous investigation regarding the change in k with change in efficiency and show that in the case of metal-filament lamps at a given specific consumption, k is the same to within small differences for all lamps of the same filament material, but different for lamps of different material. The above is also true for the untreated-carbon lamps but in the case of the treated or flashed-carbon lamps the exponent k varies with the treatment. In this case, however, the exponent k', for the relation between candlepower and wattage is constant for lamps of varying size and manufacture when operating at the same efficiency. As in the case of k, k' decreases with increase in efficiency.

While the method used eliminates the psychological difficulties involved in the photometric measurement of sources differing in color constituency, it does not eliminate the physiological effects, and universal agreement in measurement of the values of k can not be reached until the question of heterochromatic photometry has been satisfactorily settled. Nevertheless, as previously stated, the method has one marked advantage over the point-by-point method of obtaining candlepower values corresponding to various voltage intervals, and that is in the reduction of the number of measurements required.

The writer desires to acknowledge with thanks the assistance of Dr. A. G. Worthing in the mathematical deductions, and of Mr. Carl Linder in the electrical measurements.

16 Féry and Chéneveau, *Bulletin Societe Internationale des Electriciens* (2) 9, 1909; page 674.

17 H. E. Ives, *Electrical World* 57, 1911; page 1565.

The Melting Point of Tantalum.

Pirani and Meyer have recently carried out experiments in Berlin to determine the melting point of tantalum and have arrived at the value of 2,850 degrees centigrade as the temperature correct within forty degrees. As white-hot tantalum combines with almost any substance, especially other metals and gases, the work was conducted in a high vacuum where the pressure did not exceed 0.005 millimeters of mercury.

In measuring the temperature the Holborn-Kurlbaum and the Wanner optical pyrometers were used, the calibration being based on the known melting points of gold and palladium.

New Orleans by Night.

It is claimed by D. A. Hegarty, manager of the Commercial Department of the New Orleans Railway and Light Company, that New Orleans is the best illuminated city of the South, and is equal to any in the country in this respect. This claim is substantiated by a booklet which has just been published, entitled "Night in New Orleans." It contains eighteen views from various parts of the city, showing the illumination of the streets and buildings by night.

One peculiar feature connected with lighting in New Orleans is due to the architecture of some of the buildings, which are of the old creole style, with one or two galleries over the pavement in front of the house. In order to properly illuminate the sidewalk under these galleries, streamer lighting was adopted and this is in use in a number of the streets. Many of the streets have arc-lamp installations, and in some both the arcs and the streamers are utilized. Sign lighting has also reached considerable development.

New York Section Illuminating Engineering Society.

The next meeting of the New York Section, Illuminating Engineering Society, announced for December 8, has been postponed to December 14.

Death of Caryl Haskins.

Caryl Davis Haskins, manager of the lighting department of the General Electric Company, and one of the best known electrical men of this country, died Saturday morning, November 18, in Salt Lake City. Mr. Haskins was stricken with pneumonia while on a business trip in the west, and the end came very unexpectedly. Mrs. Haskins and their little son were with Mr. Haskins at the time of his demise. The body was removed to Mr. Haskins' home at Schenectady, where a brief funeral service was held Wednesday, November 22, temporary interment taking place in that city.

Mr. Haskins was born in Waltham, Mass., May 22, 1867, and was educated in England, where he specialized in mathematics and physics and took a special course in surveying and fortification work. Early in 1887 he entered the employ of the firm of Haskins, Davis & Company, mechanical engineers of London and Boston, Mass. Here he applied himself to engineering work on early gas engines and special book-binding machinery. In 1888 he entered the employ of the S. Z. deFerranti & Company as one of its junior assistant engineers, where he had charge of the manufacture of electrical meters and assisted Mr. deFerranti on the drawings for the original Deptford electric light station.

In the autumn of 1889 he entered the employment of the Thomson Electric Welding Company, Lynn, Mass., as designing draftsman. Two or three months later he was employed by the Thomson-Houston Electric Company, Lynn, Mass., as an electrical engineer. In 1891 he was appointed manager of the meter department of this company, and after its consolidation with the General Electric Company Mr. Haskins retained this position, including general supervision of the engineering and manufacture of instruments.

At the beginning of the Spanish-American War, Mr. Haskins proffered his services to the government and organized a corps of electrical engineers and men trained in electrical work, of which he was made commander. In the laying of the submarine mine defenses of Boston Harbor, the erecting of searchlight and range-finding stations and other similar work during the war Mr. Haskins and his command gave valuable service. He also gave invaluable aid in an advisory capacity in connection with other defense work on the north Atlantic Coast. Under his supervision the temporary generating stations at Fort Warren and Fort Nahant were erected, as well as all the range-finding and communicating stations on the New England coast. The work in Boston Harbor involved the charging and laying of some 200 mines. At the conclusion of the war Mr. Haskins resumed his position with the General Electric Company. He had made a special study of electricity as applied to offense and more particularly defense in time of war and was considered an authority on this subject. After the close of the war he frequently acted in an advisory capacity to the Government in various matters of this nature.

CARYL D. HASKINS.

Since 1898 he has been in demand as a lecturer before the various Army and Navy institutes, and has lectured and prepared papers for the War College, Washington, the School of Submarine Defense at Ft. Totten, and the Signal Corps School at Ft. Leavenworth, Kans. He also had the honor of lecturing before the Franklin Institute.

Upon coming to Schenectady eleven years ago Mr. Haskins was given charge of the electrical switchboard industry of the General Electric Company, and in 1906 was appointed manager of the lighting department of the company.

Mr. Haskins was greatly beloved by all his associates and had an unusually wide circle of friends who will long cherish the memory of his charming versatility and brilliant intellect.

He was also well known as the author of many technical papers before the various engineering societies and was in demand as a lecturer at various technical colleges and institutions. He was known in the literary world as the author of several standard works on electrical subjects, and was also the author of a number of successful short stories. He was a member of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, of the National Electrical Light Association, and associate member of the Military Service Institute and the United States Naval Academy.

Mr. Haskins was very prominent in Schenectady society, being a member of the Mohawk Golf Club, the Mohawk Club, local branches of various engineering societies and the Antlers Golf Club of Amsterdam. He was also a member of the Engineers Club of New York and the Massachusetts Society of the Sons of the Revolution.

English Course in Dynamo Design.

A recent issue of the London *Times* makes mention of a special course in dynamo design which is being given at the City and Guilds (Engineering) College, South Kensington, England.

The course is intended for post-graduate and other duly qualified students, the number of whom will be strictly limited, and its purpose is to prepare men to take up positions as designers in electrical works. It will include a full study of the problems arising in consideration of the factors involved in the electrical and mechanical designs of electric machinery, with detailed manufacturing and standardizing.

The lecturer will be W. E. Robson; and the lectures, about forty-five in number, will be delivered during the first half of the session (October to February), the practical work beginning in October and continuing throughout the session. Ratings, frame sizes, windings, et cetera, for complete lines of machines will be considered in detail, as well as the factory organization required for systematic manufacture and for developments.

Practice in designing, estimating, and drawing office work will also be given, with advanced laboratory work relating to the limiting conditions existing in modern machines. The fee for the whole course will be £22 ($110).

Industrial Power

MOTOR-DRIVEN FIRE PUMPS AND THEIR CONTROL.

BY GEORGE J. KIRCHGASSER.

It is possible that the American people, particularly those of the United States, are beginning to realize the necessity for improving the construction of buildings and for providing adequate means for fire prevention and protection. The fact that insurance can be obtained should not alter matters as property destroyed is gone forever and the insurance money received to compensate for fire loss is only the result of a tax levied on all insurers. Fire losses per capita in some sections of the United States reached $3.66 according to the United States Geological Survey, while in Austria this loss was only twenty-nine cents, in Italy twelve cents, and in France thirty cents.

Absolute prevention of fire is, of course, ideal but also impossible. Therefore protection is required and an adequate water system with proper distribution and pressure is an important feature. As in many other fields, the introduction of electric power and electric control has resulted in many changes in fire-protective apparatus, such as pumps, etc. Rotary steam and piston pumps have been and still are in use but in addition to the drawback relating to the piping of steam, etc., there is also the troubles with valves and the liability of shut-downs. Gas engines cannot stand the overloads occurring in fire-pump service and give trouble at times on starting.

While electric motor-driven geared triplex power pumps, such as the Goulds and Deming, are effective for fire protection and general water-supply service, yet the centrifugal and rotary turbine pumps have come into great favor. These pumps can be directly connected on the same shaft with the motor, the natural high speed of electric motors really being the main reason for the introduction of these high-pressure pumps.

The design of centrifugal pumps has also advanced rapidly so that good efficiences are possible at both high and low heads. For both high and low-pressure fire-service systems, the centrifugal pump is well suited because of the simplicity and absence of valves and rubbing parts, and also on account of its smooth action. The severe conditions of fire service demand that the motor at no time be overloaded enough to trip the circuit-breakers and the pump must be kept in operation at all hazards. The operation must also be maintained under varying conditions as when different numbers of hydrants and sprinkler heads are opened.

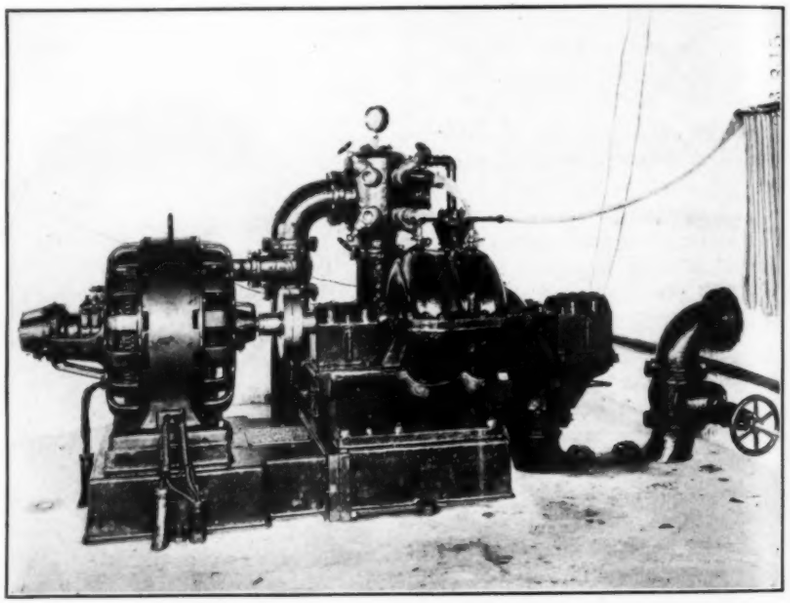


FIG. 1.—HORIZONTAL-TYPE, TWO-STAGE, CENTRIFUGAL FIRE PUMP.

Both horizontal-shaft (see Fig. 1) or vertical-shaft types of centrifugal pumps are used, although the former are installed to a far greater extent. Where the lift is very high or where, because of dirt or dampness, it is not advisable to place the motor at the same level with the pump, the vertical pump is well suited. It can be placed within easy reach of the water and the shaft extended and motor placed at a higher level where it can be well taken care of. With this arrangement some form of thrust bearing is required to take the weight of the pump impeller and the shaft and a separate thrust bearing for taking the weight of the driving shaft.

Four-stage pumps are in use to a considerable degree although pumps of two and three stages are also permitted by the Underwriters. The four standard capacities are 500, 750, 1,000 and 1,500 gallons per minute, each pump being guaranteed to discharge its full rated capacity at its rated speed against 100-pounds pressure and at an efficiency not less than 50 to 55, 55 to 60, 60 to 65 and 65 to 70 per cent, respectively, for the above four sizes. The maximum speed recommended is 1,800 revolutions per minute.

The power required to discharge 250 gallons per minute at a pressure of 100 pounds is theoretically 14.6 horsepower. Adding to this the power necessary to lift against suction and the losses in pipes and connections increases this figure to about sixteen horsepower. With a pump efficiency of 60 to 65 per cent this would mean about twenty-five horsepower to deliver 250 gallons at 100-pounds pressure. The table showing the power required to drive the four capacities of pumps is calculated on the above basis, and is given on the next page.

POWER REQUIRED FOR PUMPS.

Size of Pump.	Efficiencies. Per cent.	Horsepower Required.
500 Gals. per min.	50 to 55	64 to 60
750 " " "	55 to 60	88 to 80
1,000 " " "	60 to 65	107 to 100
1,500 " " "	65 to 70	148 to 138

In most cases the pump, motor and control panel are placed in a separate well-drained fireproof pump house, separate from the main building or built inside with an exit to both the building and to the exterior. A waterproof shield is placed between pump and motor for protection from water leakage. The current supply must be reliable at all times, twenty-four hours per day and every day. The supply must be ample and the feeders and motor leads of sufficient capacity so as not to cause drop in voltage.

The Underwriters recommend two independent sources of current to the pump, or supplies from two separate sections of an Edison network, separated by one or more junction boxes. Of course, where current is generated in an isolated plant there will be only one source but in all cases this should be transmitted in the very best manner, lead-sheathed cable in underground conduit being the best means. Sometimes with isolated plants an emergency supply is provided for from a central station. Overhead lines are in danger in times of fire, therefore, underground cables are preferred. Conduit wiring is safest for the interior of pump rooms and is used in most cases.

The voltages generally used are 110, 220 and 500, direct current and 220 and 440 volts, alternating current, three phase. In the vicinity of Buffalo and Western New York 2,200-volt three-phase motors are used considerably for driving fire pumps. Where transformers are used they are installed outside or in a separate fireproof enclosure cut off from the pump room and well ventilated. No fuses are placed in either the primary or secondary leads of the transformers.

On direct-current circuits shunt or compound-wound motors are used and on alternating-current lines squirrel-cage and slip-ring polyphase motors are used. Where alternating current is to be used the question usually arises as to the selection of the type of motor. At first thought the squirrel-cage motor might be favored because of its simple construction and lack of commutator or slip rings, but a closer study of the problem proves that all things considered the wound-rotor type is better adapted for fire-pump driving. With the squirrel-cage motor, auto-transformers must be used and the starting current is very high. The wound-rotor type with its slip rings is not in itself as simple as the squirrel-cage motor but the starting and controlling devices are more simple and reliable. The motor can also be started with lower starting current. The combined cost, which is a feature not to be overlooked, of the squirrel-cage motor and automatic manual starter is greater than that of the slip-ring type of motor with its simpler starting panel. Motors having good starting characteristics are desirable for fire-service duty.

The controlling equipments used with motor-driven fire pumps are very interesting. Fig. 2 shows an alternating-current automatic and manual fire-pump starter for use in connection with a three-phase slip-ring motor. In some cities, as Chicago for instance, a starter which acts automatically and can also be manipulated by hand is usually required.

The controller shown consists of four double-pole solenoid switches, the first at the left closing the primary circuit while the other three cut out steps of resistance in the secondary circuit of the motor. The primary switch is controlled by means of the pressure governor shown at the foot of the illustration which closes the circuit and starts the pump when the pressure in the system falls below a predetermined low value and opens the circuit when the pressure reaches a maximum value. The series relays mounted below the three secondary switches control the operation of these switches so that the starting current is kept about constant avoiding excessive current inrushes during the starting period. Resistance is cut out from each of the three phases in equal steps, maintaining balanced conditions.

To take care of the hand operation a horizontal shaft with a hand lever at the left is mounted below the switches. By means of cams the switches are closed in order when the shaft is revolved. A latch, shown at the left of the left-hand solenoid switch, holds the shaft in the full-on position but will release it upon failure of voltage, the controller returning to the starting position with all resistance in. The meters, main switches, etc., used with this starter were mounted on a

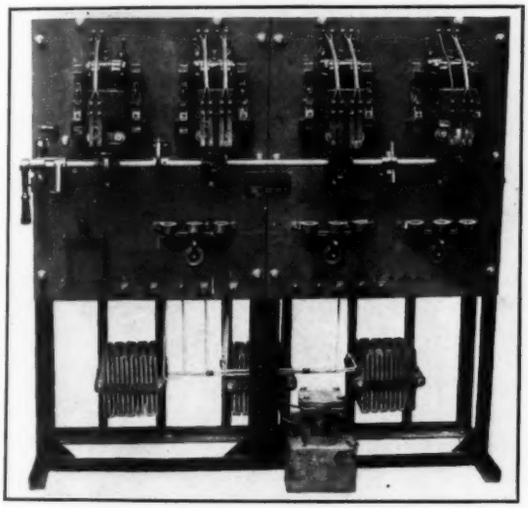


FIG. 2.—AUTOMATIC AND MANUAL STARTER FOR THREE-PHASE MOTOR.

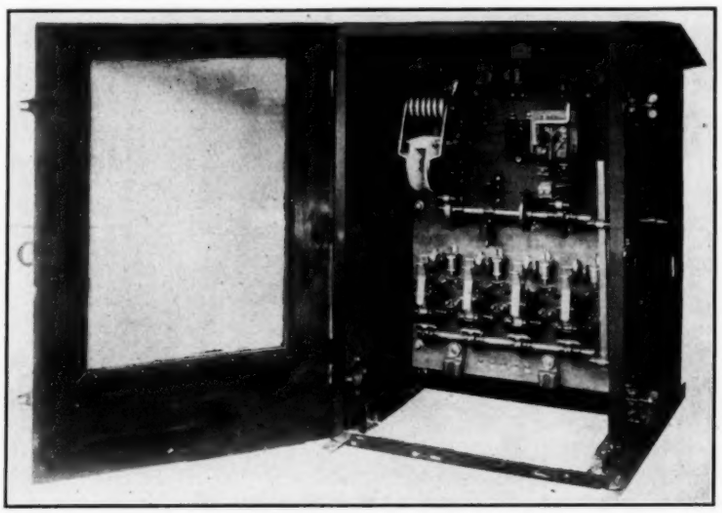


FIG. 3.—CUTLER-HAMMER STARTER FOR FIRE PUMP.

separate panel. The double-pole switch in the lower left-hand corner is simply in the solenoid circuit. It will be noted that the motor is started automatically or manually by the same contact elements and no switches have to be opened or closed to allow either action.

A direct-current Cutler-Hammer Schureman type starter, mounted in an inclosing case, is shown in Fig. 4. These cases are usually placed on angle-iron stands, two to three feet above ground.

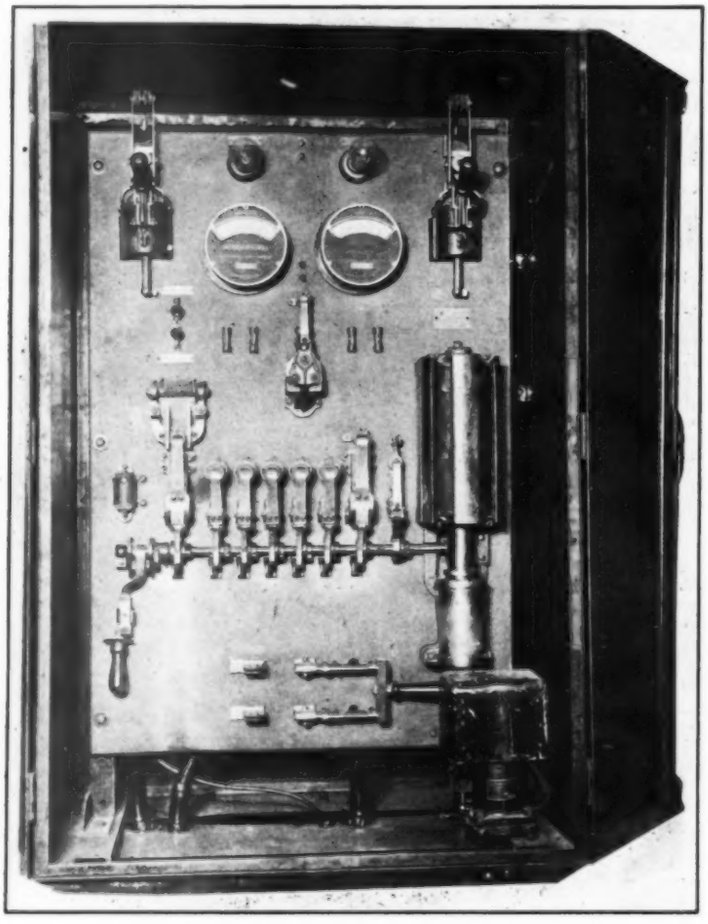


FIG. 4.—SCHUREMAN-TYPE STARTER.

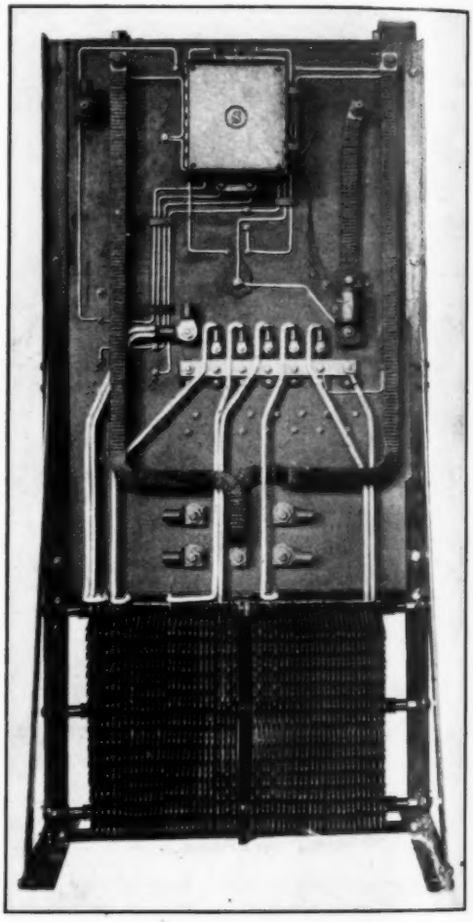


FIG. 5.—REAR VIEW OF STARTER.

This type of fire-pump starter is used to a great extent, many being installed in Chicago. One was recently installed in the Chicago City Hall for use in connection with a 150-horsepower motor driving a pump delivering 750 gallons per minute to a tank. The solenoid at the right revolves the shaft carrying a series of butt-contact switches, which are closed in succession cutting out the resistance and bringing the motor up to speed. The pressure governor at right-hand lower corner controls the solenoid circuit. Manual operation is provided by turning the same shaft by means of the lever at the left. The double-throw switch at the bottom allows connection to two sources of current supply, the leads to the motor being connected to the hinges of the switch. An ammeter and voltmeter are provided with indicating lamps and single-pole circuit-breakers connected in the motor leads. Fig. 5 shows the rear of this type of starter, showing the asbestos-covered wires, covered-copper bars, and the resistance grids. Although usually placed in cases, all iron parts are copper plated or replaced by brass and the slate panel is also treated to repel moisture.

Fig. 3 shows another direct-current type of fire-pump starting panel in which the lever for manual operation is passed through the right side of the case. A wire glass window is also placed in the door. Four "clapper-type" switches are used for cutting out the resistance while the main circuit is opened and closed by the contactor switch in the upper left-hand corner.

All of the types of controllers illustrated have been in use for a number of years and by their aid the electrically driven fire pump has become most reliable and economical. The results obtained are simply in line with other advances in electric-motor control.

High-Speed Electric Railway.

The City of Rome, Italy, has arranged with representatives of the Metropolitan Underground Railway of Paris for the building and operation of an electric rapid-transit line from Rome to the ancient seaport Ostia. The railway will be free from any grade crossings, so as to permit the entire distance to be covered in one-half hour. The section of the line within the city from the Piazza Venezia to the Porta S. Paolo will be entirely underground, the tunnel width being 23 feet and the internal height 15.6 feet. Outside the city the line will be elevated all the way to Ostia. The construction company has also agreed to build a large bathing establishment near the sea terminal.

Telephony · Telegraphy and Wireless

The Fontana Mast.

An extensible metallic mast is being tried in Germany and possesses some novel features. The apparatus is called the Fontana mast, and it was designed to provide a metallic mast which can be quickly raised or lowered, but without the disadvantages of a telescopic mast. This latter has not come into very extensive use for several reasons, the main one being that since the tubes must fit into each other very closely, their erection is likely to be hampered by sand or ice, or in other cases by the rusting of the metal. In addition, where a telescopic mast has to carry a load it is difficult in practice to erect it without using complicated mechanical apparatus at the base of the mast; this makes it expensive and limits its applications.

The Fontana mast is of interest owing to the new principle involved, and it is claimed that the design overcomes most of the drawbacks which up to the present time have limited the applications of such masts in electric work. A four-sided hollow mast is formed of four flexible steel strips. The edges of these strips have teeth cut in them in such a way that the teeth of one strip interlock with the recesses of the adjoining one, so as to join the four strips at their edges. The teeth project to some extent. This makes up a hollow column, and it remains to brace it. For this purpose thin sheet-steel brace plates are placed at frequent intervals.

The mechanism for raising or expanding a mast of this kind is simple. The steel strips are wound upon drums and a second set of drums is mounted below to feed out the strip and guide it properly. These latter drums have projecting teeth around the center which engage in holes in the steel band. A chain drive connects both drums, and the lower or feeding rollers are driven by a hand crank or in other cases by an electric motor.

As the four steel hands pass up through the guide plate they become interlocked and form the steel tube. Upon the guide plate is a pile of section disks. The top head of the mast carries the first of a set of links which go to join all the section plates. When the head rises in the first place, it picks up the first section disk by means of the first four links placed on the four sides, so that the disk is automatically fitted around the column. As the mast continues to rise, the second disk is taken along in the same way; the result is that the section disks are situated all along the mast, their spacing depending on the length of the link which is determined according to circumstances. A light portable mast, such as is used for wireless telegraphy, can be raised to twenty meters height using a base about one meter square. When lowered, the height of the apparatus is only 1.7 meters and it weighs 175 kilograms. The bending stresses are taken up by a short column, which projects up the center and transmits the stresses to the base. Means are provided for clamping the base of the mast tightly against the bottom column.

A crank attached directly to one of the drums, or by gearing, can be used for raising and lowering the mast and the remainder of the drums do not need gear drive, as the rest of the strips are drawn along by means of the interlocking teeth. It is evident that sections varying from three sides to eight sides can be employed, but in practice the square or hexagonal forms are found to be best; the eight-sided form is more complicated and not much more useful. The mast is strongly braced by the section disks; these are calculated so that the mast can stand a given maximum load without the steel strips bending. The length of the teeth which engage with one another must be such that the strips are prevented from bending inwards. For stamping the strips and obtaining the spacing of the disks a set of curves are used, based on a load of 2,500 kilograms per square centimeter, assuming a certain thickness of strip and a certain factor of safety.

The strips employed are made of tempered crucible steel or of Swedish steel of great tensile strength. For the lighter masts the thickness of metal should be at least 1.5 millimeters, and for heavier masts this is increased to suit the case. The Fontana masts are made in sizes to reach a height of eighty feet and carry a load of two tons. The manufacturer is the Fontana Maste und Träger Gesellschaft, Berlin, Germany.

Inexpensive Wireless Stations.

United States Consul J. S. Benedict, of St. Johns, gives some interesting results of the recent visit of Mr. Marconi to Newfoundland. It is understood that Mr. Marconi was entirely satisfied with the work done while there. A temporary experimental station was established at Fort Amherst, at the entrance to St. Johns Harbor, and a series of poles were erected, beginning at Fort Amherst, to the highest point on the Southside Hills. Messages received at Glace Bay, Nova Scotia, from Great Britain have not yet been entirely satisfactory, and Mr. Marconi doubtless recognized that Newfoundland had been the impediment, and that messages could be received there without the interruptions and disturbances to which they are subjected at Glace Bay.

By Mr. Marconi's experiments at Newfoundland he has demonstrated that it is not necessary to have expensive towers erected in order that the work may be properly carried on. A wire run from the lighthouse at Fort Amherst to the top of the hill and attached to an ordinary pole has been found to do as good work as the most costly tower. This means a great deal, as in future any station can be put up in a short time at a trifling expense and then taken down when the necessity for it has disappeared.

The extension of the system of wireless telegraphy on the Labrador coast will be a logical sequence of the new method. It is likely that the Marconi Company will come to Newfoundland to strengthen its position in the competition for telegraphic business.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

KEYSTONE TELEPHONE OF PENNSYLVANIA.

The Keystone Telephone Company of Pennsylvania reports for the month of October and four months ended October 31, 1911, are compared as follows:

	1911.	1910.
October gross	$ 97,724	$ 96,345
October net	48,542	48,029
Surplus after charges	23,588	23,510
Four months' gross	388,330	379,154
Four months' net	190,264	189,616
Surplus after charges	90,874	91,457

LONDON UNDERGROUND.

The associated companies of the Underground Electric Railways Company of London report for the month of October, compared as follows:

	1911.	1910.
Metropolitan District Railway.		
Gross receipts	£61,953	£59,280
Working expenses	28,664	28,439
Net receipts	33,289	30,841
London Electric Ry. Co.		
Gross receipts	£65,470	£61,549
Working expenses	32,715	31,039
Net receipts	32,755	30,510
London United Tramways, Ltd.		
Gross receipts	£26,252	£28,149
Working expenses	18,271	20,600
Net receipts	7,981	7,549

CITIES SERVICE COMPANY.

The Cities Service Company reports the following for the twelve months ended October 31, 1911: Gross earnings, $915,865; net earnings, $885,987; dividends, $653,310; surplus, $232,677.

The earnings for the month of October compare as follows:

	1911.	Increase.
*Gross earnings	$84,961	$19,641
Expenses	2,779	2,229
Net earnings	$82,201	$17,411
Dividends	56,626	6,663
Surplus	$25,575	$10,748

*Earnings on stocks of subsidiary companies and miscellaneous income.

EDISON ELECTRIC OF BOSTON.

The report of the Edison Electric Illuminating Company of Boston for the month of October and four months ended October 31, compares as follows:

	1911	1910
October gross	$ 478,310	$ 427,636
Expenses	194,395	183,855
October net	283,915	243,781
Four months gross	1,640,809	1,458,619
Expenses	732,877	679,687
Four months net	907,932	778,932

WEST PENN TRACTION COMPANY.

The West Penn Traction Company reports as follows for the fiscal year ended September 30, 1911:

Gross earnings	$2,107,215
Operating expenses and taxes	1,054,953
Net earnings	1,052,262
Fixed charges	642,824
Surplus	409,438
Preferred dividend	97,500
Surplus	311,938

NIAGARA, LOCKPORT & ONTARIO POWER.

The Niagara, Lockport & Ontario Power Company reports for the nine months ended September 30, 1911, compared as follows:

	1911	1910
Gross earnings	$410,299	$383,064
Operating expenses, etc.	153,255	150,366
Net earnings	257,044	232,697
Other income	17,197	12,371
Total income	274,242	245,068
Charges	187,500	187,500
Surplus	86,742	57,568

KANSAS CITY RAILWAY.

The annual report of the Kansas City Railway & Light Company for the year ended May 31, 1911, shows a surplus of $570,966, equal to 4.7 per cent on the $9,543,080 common stock outstanding after allowing for the full five per cent dividends on the preferred. This compares with 4.16 per cent earned on the same stock in the previous year:

The income account compares as follows:

	1911.	1910.
Gross	$7,727,680	$7,161,041
Expenses	4,450,534	4,153,249
Net	$3,277,145	$3,007,792
Other income	45,491	17,399
Total income	$3,322,637	$3,025,191
Charges, etc.	2,398,889	2,157,962
Surplus	$ 923,847	$ 867,229
Preferred dividends	352,781	470,375
Surplus	$ 570,966	$ 396,854

Western Electric Sales Growing.

In sharp contrast with September, in which month sales of the Western Electric Company showed an increase of twelve per cent over September, 1910, October shipments showed a decrease of five per cent as compared with October a year ago. At the time, however, it was explained that the September gain came from orders booked earlier in the year, the company computing its business on the basis of shipments and not orders received, and that September's good showing did not mean an increase in orders received during that month.

But two more months of the company's year remain and it now seems fairly certain that the whole year's business will run very close to $66,000,000 which will make 1911 the second best year in the company's annals, being exceeded only by 1906, with sales of $69,000,000. An encouraging feature of the rapid strides the company made in the last three years is that the growth has been under normal conditions, and should, therefore, prove to be more or less permanent in character. The 1906 year was one of abnormal development in the telephone and allied industries, followed by a violent reaction.

Sales of the Western Electric Company for the ten months of the current year are about three per cent ahead of last year, the foreign branch of the company's interest showing up somewhat better than domestic business. In the United States during October all sections except the Pacific Coast district showed decreases. The East has been the section of the country to show the greatest falling behind.

Telephone Merger Proposed.

Bondholders of the United Telephone & Telegraph Company have received a circular embodying a proposal by the Telephone Investment Company for the reorganization of the American Union Telephone Company, the Consolidated Telephone Companies of Pennsylvania and the National Telephone Corporation and underlying companies.

It provides for the formation, under the laws of Pennsylvania, of a new corporation with a capitalization of $35,000,000 to be known as the North American Telephone & Telegraph Corporation.

This company is to acquire title to all the property, assets, franchises and good will of a large number of telephone companies in Pennsylvania and also to acquire, by purchase or otherwise, the capital stock of the New York State Telephone Company, Cumberland Valley Telephone Company of Baltimore; American Union Telephone Company of Virginia, and the United American Telephone Company of West Virginia.

General Electric Earnings High for 1911.

The General Electric Company should show gross earnings of about $68,000,000 for the year ending December 31. This includes total sales, profits on sales of stocks and bonds, royalties and incomes from various accounts, etc. It will be a decrease of about $6,000,000 from that of last year, accounted for by the fact that business in the electrical trade has not been as brisk in 1911 as in 1910, and also by the low prices received for product sold. Orders for small electrical goods, such as fans, motors for domestic and industrial equipment, etc., have been very good this year, but sales of large equipment, such as big generators, heavy motors and electric railway equipment have been somewhat less than last year.

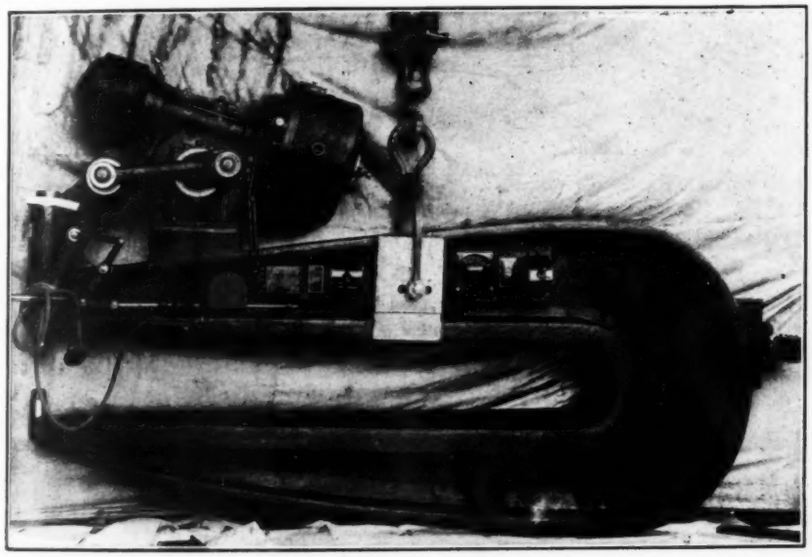
New Electrical and Mechanical Apparatus and Appliances

Novel German Flywheel Electric Riveter.

The accompanying illustration shows the construction of a novel German flywheel electric riveter developed at Leipzig-Sellerhausen, by the Leipziger Maschinenbau Gasellschaft. One type of this German electric riveting machine has been designed with friction clutch, to rivet all sorts of ironwork, including rails and objects that do not require steam-tight rivets.

In these electric riveting machines the motor moves the flywheel that accumulates the energy, and for this reason the motor is safeguarded and its utilized for driving, so that it is moving at the maximum pressure and therefore unfailingly safeguards the machine and its parts from being damaged. In order to protect the motor from excessive overload, which might occur, if the cup-shaped dies should be inaccurately fixed, another fuse is provided.

It is stated that the cost of operation, as well as the first cost, is extremely low, as the central compressor-station equipment is not necessary as with pneumatic or hydraulic machines. It is said that more than 2,000 rivets can be placed per hour, provid-



ELECTRIC RIVETING MACHINE.

burning up is said to be absolutely impossible, while there is also the advantage of an extremely low current consumption and loss of power.

The machine consists of a steel casting, having on its upper part the lever mechanism, as on the pneumatic riveting machines. This lever is moved by a connecting rod, which is operated by an electric motor through a worm and a screw-wheel. The motor drives, through its elongated shaft, the flywheel and a set-bolt pulley. The movement of the lever and the cup-shaped dies is obtained by engaging and disengaging a clutch coupling. An accurately operating slide coupling is

ed the workmen are able to follow the machine with the necessary rapidity. This rate of 200 rivets per hour may still be increased, since a machine for one-inch rivets makes ten strokes a minute. Therefore the productive work of the machine is not limited to 200 rivets per hour.

Although rapid work is accomplished the finished rivets obtained are of most excellent quality, and in case the rivet is put into the hole properly it is found to be completely welded together with the sheet. This condition has been found in test pieces which were cut through after riveting.

It is held that the amount of power required is very low, a machine driving three-quarter-inch rivets utilizing a motor of two horsepower, and for one-inch rivets one of 3.5 horsepower, with a good margin of power giving at full working a reserve of fully fifty per cent. The loss of power is also said to be extremely low. With a motor of continuous-current type running at 200 volts it has been found that running without load, only from two to three amperes were used, while during the riveting process eight to ten amperes were required. These results are undoubtedly of great interest and, it is claimed, cannot be attained by either the pneumatic or hydraulic system.

Electric riveting is said to provide absolute safety in working as the safety coupling arranged within the flywheel moves with excessive pressure and the fuse breaks the circuit if the motor should be heavily overloaded. The rapidity with which work is done and economy of operation are all points in favor of this equipment.

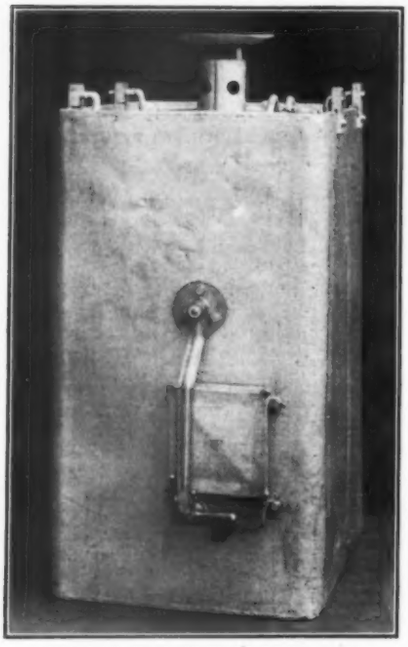
Star Dry Cell.

Efficiency Electric Company, 4524 Lincoln Avenue, Chicago, has just placed on the market the Star dry battery for which many unusual claims are made. It is claimed that this battery will ring a bell continuously for eight weeks if given a rest for four minutes at intervals of two weeks. The battery is said to possess tremendous recuperative power and that even when apparently dead its power will, after a short rest, return for a period fully as long as when first tested. The Efficiency company further claims that tests show that a Star dry cell will light a two-volt, two-candlepower lamp for seventy-two hours with rests of one hour at twenty-four-hour intervals. This would be nine times as long as any other cell on the market would hold up. It is claimed that Star batteries are not affected by moisture or dampness, and are said to be the only batteries on the market which will not dry out when out of use.

Unique Electric Self-Acting Fire Extinguisher and Alarm.

The accompanying illustration shows an interesting combination of an electro-magnetic, automatic fire extinguisher and alarm. The apparatus is of German design and consists of thermostats controlling an electric circuit connected with a magnet and lever-controlled chemical fire extinguisher.

The apparatus includes a carbonic-acid generator placed in the room to be protected, the vessel having a lid carrying a small receptacle to catch any solution discharged with the carbonic-acid gas as it is emitted from the openings of the turret-shaped fitting at the top.



AUTOMATIC FIRE EXTINGUISHER.

An electromagnet sets the chemical fire extinguisher in action as soon as one of the thermostats become heated above a predetermined temperature.

As soon as the thermostat in the room to be protected makes electrical contact by an excessive temperature, a pawl is disengaged by the electromagnet in a small chamber on the outside of a fire extinguisher. This releases a lever which causes a small tank containing sulphuric acid to be discharged into a tank containing a solution of potash.

Large volumes of carbonic acid gas produced by the mixture of the acid and potash solution are thrown into the room by a surplus pressure varying up to one atmosphere.

The self-acting fire alarm and indicator connected with this automatic fire extinguisher consists of a bent double-metal strip composed of two metals of different thermic expansion rolled upon one another at very high pressure, and any excessive increase in temperature will cause the metal strip to straighten far enough to lift the contact of the alarm. This thermostat is provided with a disk and scale which allows the fire alarm to be adjusted to any temperature between 35 degrees and 100 degrees centigrade, as desired.

There is a switch provided at the door of the room or rooms being protected to throw out of circuit the disengaging magnet of the carbonic-acid-gas fire extinguisher in order to prevent the same from being operated during the presence of a person in the room. Push buttons are also located outside the room, in the office or anywhere desired, so that the fire extinguisher may be placed in operation when desired by hand, the electromagnet disengaging the pawl which controls the lever.

Single-Phase Railroads Break Snow Blockades.

It has been found that during the winter when the steam trains are unable to get through without considerable delay, electric trains operating on parallel routes hold very closely to their schedules. On a steam road the ability of a steam locomotive to haul loads is actually reduced in cold weather because of the greater losses of heat from the locomotive. The reverse is true with an electric locomotive, because in cold weather the motors are maintained at a much lower temperature than in warm weather, hence their ratings are increased.

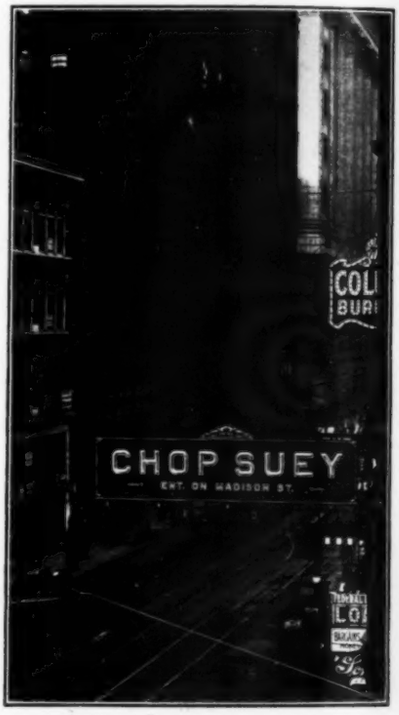
That the single-phase system is inherently fitted for electric railways is well illustrated by some experiences that the Spokane and Inland Empire Railroad, which operates a 11,000-volt, single-phase line in the State of Washington, has had during the last two years.

The only plow used on the Spokane and Inland trains was one of the usual shield type mounted on the pilot. This has proven to be entirely effectual in keeping the line clear enough of snow for satisfactory operation.

The winter of 1909 and 1910 was one of the most severe ever experienced in that vicinity. The Spokane and Inland was the only local road that maintained its regular scheduled service through this trying winter. At no time during the worst storms was any Spokane and Inland train more than twenty minutes behind its schedule.

The Flexlume Electric Sign.

Durability, beautiful day appearance and economy in current consumption are the principal claims made for the new Flexlume electric signs, shown in the accompanying illustrations. In the perfection of these signs the manufacturer states that it has been the aim



FLEXLUME SIGN BY DAYLIGHT.

of the company to produce a sign that would appeal particularly to the large class of conservative merchants who have not favored the ordinary exposed-lamp signs because of their unsightly day appearance.

In the Flexlume signs the letters are made of prismatic glass molded in bold relief. The exterior of the glass is smooth so that the amount of dust collecting on its surface is reduced to a minimum. The entire sign, with the exception of the letters is of metal construction and can be finished as desired. Some of the recent signs are of pure copper, this forming an attractive background in daylight.

The letter sizes range from four inches to twenty-four inches inclusive,

the smaller sizes requiring only one lamp per letter and the larger sizes two lamps per letter. The lamps regularly supplied are twenty-five or forty-watt tungsten although carbon lamps can be used. The lamps are mounted perpendicularly in each letter and are easily accessible for renewing as each letter is hinged and opens out, as a door. A reflector of special metal composition is used with each lamp.

A feature of the Flexlume sign is its

FLEXLUME SIGN.

weatherproof construction, all wiring, lamps and reflectors being protected.

As to saving in current consumption the company makes the following comparison: In the sign reading "Drugs," with the letters eight inches high, a Flexlume sign would require five twenty-five-watt tungsten lamps; an exposed-lamp sign eighty two-candlepower carbon lamps. Assuming the cost of energy to be ten cents per kilowatt-hour

FLEXLUME SIGN.

and that the signs burn 1,200 hours, the cost for the Flexlume sign would be $15 as compared with $96 for the exposed-lamp sign.

Another great saving is made where two-colored signs are desired. If a red and white effect is wanted, in the Flexlume sign it is only necessary to install a red and white lamp for each letter while in the exposed-lamp sign two complete rows of lamps must be provided and the colored bulbs are exposed to the weather. The Flexlume signs are manufactured by the Flexlume Sign Company, Buffalo, N. Y.

Restoration of Telephone Service in 98 Hours.

The Missouri & Kansas Telephone Company's Fairmount exchange at Kansas City, Mo., was completely destroyed on October 22, at 3 a. m., by a fire which is believed to have been caused by an explosion of gas in the house adjoining that in which the central office was located. The telephone company at once communicated with the Western Electric Company and the work of restoring service was begun at 9:00 o'clock of the same morning, when a dozen men from the electric company's local installing force appeared upon the scene.

The Western Electric Company sent forward from Chicago, the necessary apparatus by express the same evening.

The new switchboard equipment consisted of several sections from the telephone company's stock, and some from an addition which was to be installed at the Rosedale exchange, on account of the increasing business in that district. Twenty-six workmen reported for work on October 23, and from that time until the new board was cut in service at 5:00 a. m., on October 26, with a full equipment of 800 subscribers' lines, day and night crews were at work.

Taking into consideration the fact that the work was done under high-speed conditions, in order that the subscribers might not be inconvenienced for an extended period, it is worthy of note that the trouble reports issued as a matter of routine by the telephone company indicate that the work of the Western Electric Company's installing force was so well done that a minimum of trouble was experienced after the new equipment was cut into service.

Ideal Boring Machine.

A boring machine is being placed upon the market by the Metropolitan Electrical Supply Company, 180 West Lake Street, Chicago, Ill., which is shown in the accompanying illustration. It is claimed that this is the lightest practical boring machine which has been built and it is known as the "Ideal" boring machine. It has a chain drive and a brass shaft. It

IDEAL BORING MACHINE.

takes a standard bit without any cutting or filing, the chuck being made for standard bits of the sizes five-eighths and eleven-sixteenths inch. It will bore between joists 1.5 inches wider than standard bit lengths. This boring machine is sold at a very low figure. It has given great satisfaction to its users.

Large Electric Locomotive.

The Maschinenfabrik Oerlikon has turned out an electric locomotive of unusual size and character. It is an alternating-current locomotive of 2,000 horsepower capacity, 13,000 kilogram tractive effort, and utilizes current at a pressure of 15,000 volts and a frequency 13 to 17 cycles. The machine is thus larger than that built for the Simplon tunnel by Brown, Boveri & Company, than that built two years ago for the Pennsylvania Railroad and also

than the freight locomotive built for the Italian State Railways. It is to be run on the Spiez-Lötschberg-Simplon line. It is from the designs of the engineer Thormann and is described by a contemporary as the first demonstration that with single-phase alternating current the highest requirements of existing and projected lines can be satisfied, without exceeding the Continental standards with regard to axle pressure.

Traction Growth in Ohio.

An excellent idea of the growth of interurban trolley systems may be obtained by a glance at the map of the territory covered by the Northern Ohio Traction and Light Company, the lines of which extend from Cleveland to Cuyahoga Falls, Ravenna, Akron, Wadsworth, Canton, Massillon, Canal Dover, Dennison and other Ohio cities. This company is one of the strongest and most enterprising of the traction companies in the central states which are now rapidly being covered by interurban electric lines.

Its present equipment consists of direct-current generating stations located at Bedford, Silver Lake Junction, and a small one at Nidvale. In addition to these there is a 25-cycle alternating-current generating station at Canton and feeding substations at Springfield Lake, New Berlin, Massillon and Canal Dover. At Akron there is also a 60-cycle generating station for supplying light and power to the city and also for furnishing 500-volt direct current through three 1,000-kilowatt motor-generator sets.

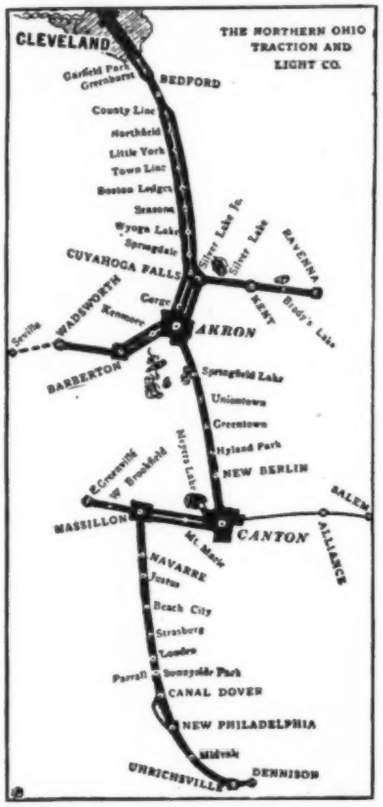
Due to the increase of load on the existing plant and a desire to centralize the power generation with its attendant economies, the company has decided to completely renew the electrical equipment of the greater portion of the system, and to this end has determined to spend a large sum.

It is the intention to install a new steam turbine and hydroelectric generating station at a point north of Akron on the line of the road known as the "Gorge." From this point current will be distributed to substations located at Bedford, Town Line, Kent, South Akron, Barberton, Springfield Lake and New Berlin.

The system south of Canton will be supplied as at present, with the exception of the fact that the small generating station at Midvale will probably be changed to a substation.

The generating plant of the new system, as well as the distribution, will be operated at sixty cycles.

The generating equipment consists of three 60-cycle, three-phase, 7,000-kilowatt turbo-generators running at 1,800 revolutions per minute; two 150-kilowatt, direct-current, 250-volt turbo-generators for exciters; nine 1,100-kilowatt oil-insulated water-cooled transformers for changing generator voltage to 7,625 volts, for use with star-connected grounded-neutral service, giving 13,200 volts transmission;



MAP OF TRACTION LINES.

one 20-kilowatt motor-generator set; three 55-kilowatt transformers, 2,300 to 440 volts; one main switchboard, for controlling above apparatus and outgoing lines.

The contract for all the electrical machinery including turbo-generators, rotaries, transformers, and auxiliary apparatus was awarded to the Westinghouse Electric & Manufacturing Company.

Equipment for New Battleships Goes to Diehl Manufacturing Company.

WASHINGTON, D. C.—Beekman Winthrop, acting Secretary of the Navy, has awarded to the Diehl Manufacturing Company, of Elizabethport, N. J., a contract to construct for the new battleships *New York* and *Texas* electrical turret-operating equipment for the sum of $77,500. There were but two bids for the work, the other being that of the General Electric Company, at $82,524.

For a number of years the Bureau of Ordnance of the Navy Department found it impossible to obtain any competition in the manufacture and supply of ordnance electrical appurtenances. Three or four years ago the Diehl Manufacturing Company entered the field, and is now a competitor for this class of work. It was the desire of the Bureau of Ordnance, if possible, that part of the present contract should be awarded to the General Electric Company, but as the Department has ruled that the whole award shall go to the lowest bidder, the Diehl concern, the General Electric Company will now for a period of at least a year be without work for the Bureau of Ordnance.

The Bureau desired, if possible, to keep in with the General Electric Company's plant and men so that if ordnance work at present unprovided for in regular appropriations should suddenly appear to be necessary, the Bureau would know that the General Electric Company was not tied up with commercial contracts which would prevent it from handling Navy Department ordnance work.

The work now awarded to the Diehl concern for the *New York* and the *Texas* is some of the most important work on the battleships, with the possible exception of the big guns and motive power. It consists of, for each battleship:

Ten upper-hoist turret equipments at	$14,935.00
Ten lower-hoist motors and brakes at	7,482.00
Ten elevating equipments at	9,040.00
Ten rammer equipments at	9,293.00

The totals amounted to $81,300, for the two ships, but the Diehl Company agreed to do it all for $77,500. The equipment for the *New York* is to go to the New York Navy Yard and for the *Texas* is to go to the Newport News Shipbuilding & Dry Dock Company, where the ships are being built.

The Diehl Company's first contract for turret ordnance electrical equipment was for the ships of the type of the Dreadnaught *Delaware*. It also obtained a similar contract for the battleship *Arkansas*. The General Electric Company obtained this class of work for the new battleships *Florida* and *Utah*.

W. B.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

From recent developments it is evident that preparations are being made by the Public Service Commission, First District, for the rejection of subway bids amounting to more than $23,000,000 and to readvertise for the building of vital Broadway sections of the new subway route. Official announcement was made setting November 24 as the date for the public hearings "upon the proposed terms and conditions for the construction of sections 1, 2, 2A, 3 and 4 of the Lexington Avenue Rapid Transit Railroad." In May, 1910, public hearings were held on the same question, and in October, 1910, many large contractors submitted bids for the work. The sections discussed on November 24 extend under Broadway from Vesey Street to Fourteenth Street, and also from Vesey Street to the Battery, running under Greenwich and Church Streets, and are regarded as the most vital territories in the future rapid-transit development of the city.

The Public Service Commission, Second District, has prescribed a uniform system of accounts for telephone corporations in the State of New York. A public hearing was held on October 4, at which time representatives of the telephone companies were given an opportunity to be heard upon this subject. The tentative scheme of accounts issued in July, upon which the hearing was held, has been modified in a few minor particulars and as revised is now made the subject of an order by the Commission to become effective on January 1, 1912. Copies of the order will be served upon all telephone corporations subject to the Commission's jurisdiction as soon as the pamphlet can be had from the State printers.

The Public Service Commission, Second District, has served upon the Buffalo General Electric Company and the Cataract Power & Conduit Company the complaint of the Mayor of the City of Buffalo asking for an investigation regarding the prices charged the city of Buffalo for electricity used for the purpose of light, heat and power. The complaint alleges that the prices charged by the two companies are unjust and unreasonable and asks that the Commission fix a maximum price to be charged. The companies have been required to answer the complaint within twenty days.

On Monday at Albany the Commission heard the petition of the Wayne County Gas & Electric Company for construction and exercise of franchises in the town of Manchester and the village of Newark, and the complaint of the Reasonable Fare Association against the Schenectady Railway Company as to rates of fare between Schenectady and stations between Lathams and Niskuna and between Troy and said stations on the Schenectady-Troy line. On Tuesday at Albany the application of the Red Hook Light & Power Company which seeks to exercise franchises granted to it by the city of Hudson was heard. On Wednesday at New York the Commission heard the complaint of the Municipal authorities of the town of Eastchester against the Westchester Electric Railroad Company as to lack of waiting room at Waverly Square and condition of passenger car operation between Tuckahoe station and Waverly Square; the complaint of Charles Berger against the New York Telephone Company as to the refusal to allow credit for unused messages under "minimum" contract; and the complaint of purchasers of gas in Rockville Center and other places against the Nassau and Suffolk Lighting Company as to the price charged for gas. On Thursday at Albany the Commission held a hearing upon the complaint of the city officials of Oneida against the New York Central & Hudson River Railroad Company as to the blocking of street crossings and highways in that city; and upon the matter of requiring all electrical, municipal, telephone, telegraph, railroad and street railroad corporations to stencil and number their poles and structures for carrying overhead wires.

INTERSTATE COMMERCE COMMISSION NEWS.

(Special Correspondence.)

A complaint has been filed with the Interstate Commerce Commission by Kansas City against the Kansas City Viaduct & Terminal Company, Metropolitan Street Railway Company and the Kansas City Western Railway Company. It is alleged that the Metropolitan Street Railway Company is engaged in the transportation of passengers between Kansas City, Mo., and Kansas City, Kans., as does the Kansas City Viaduct & Terminal Railway, commonly known as the Bridge Company. The Kansas City Western, or what is commonly known as the Leavenworth Line, is also engaged in like business.

The Bridge Company owns a bridge running over the Kaw River on which it operates a double line of electric street railway cars, connecting at each end with the lines of the street railway company from which it exacts a toll of one cent per passenger, the aggregate number of passengers reaching six million passengers per annum. The Leavenworth Line for about four years prior to August 1, 1911, transported annually about one-half million passengers over the Bridge, for all of whom they paid the toll of one cent per passenger.

Since that date, and owing to some dispute as to monetary arrangements due for past services, the Leavenworth Line has been excluded from the use of the Bridge; this is also true as to the Indiana-Minnesota cars, causing both lines to use another transfer, causing delay and inconvenience to their passengers. They ask for an order establishing a joint through route via the bridge, and to afford reasonable facilities for the receipt, forwarding and delivery of passengers, and to cease from excluding cars of defendants from the use of the bridge.

LIGHTING AND POWER.

(Special Correspondence.)

FREEMAN, S. D.—A co-operative company is proposed to install an electric light plant. C.

GRAYETTE, ARK.—This city is soon to begin the construction of an electric light plant.

BRAINERD, MINN.—The Water and Light Board will extend electric lights to the Mill district. C.

CLARA CITY, MINN.—H. Schmidt, of Dawson, Minn., has asked for an electric light franchise.

McKITTRICK, CAL.— The Kern River Oil Company is installing new electric pumping machinery. A.

CHATHAM, VA.—An electric light franchise has been granted to F. L. W. Brayant, of Thomasville, N. C.

NEW ORLEANS, LA.—The El Salto Power Company has been incorporated with a capital stock of $300,000.

STORY CITY, IOWA.—The Commercial Club has arranged for installing sixteen electroliers on Broad Street. C.

ST. LOUIS, MO.—The National Light & Power Company has been incorporated with a capital stock of $2,000.

PLANADA, CAL.—The San Joaquin Light & Power Company will install an electric-lighting system at Planada. A.

ST. LOUIS, MO.—The Light & Development Company has increased its capital stock from $100,000 to $200,000.

CENTRALIA, WASH.—The Centralia Light & Traction Company has commenced the erection of a new power plant. A.

MURFREESBORO, ARK.—E. L. Timmons, of Shawnee, Okla., is considering the establishment of an electric light plant.

ANETA, N. D.—A franchise has been granted to the Aneta Light & Power Company to establish an electric light plant.

MINOT, N. D.—The City Commissioners let the contract to the Consumers Power Company, to furnish the city with light. C.

HAMLIN, TEX.—The Hamlin Electric Light, Heat & Power Company has been incorporated with a capital stock of $10,000.

WALLACE, IDAHO.—The Iron Mountain mine, near Wallace, plans for the erection of an electric power plant to cost $100,000.

MAZEPPA, MINN.—The Council is considering installing a steam or gasoline engine as an auxiliary for the local electric light plant. C.

FOLEY, MINN.—The Battery Company, Milwaukee, was granted a franchise for an electric light plant. Otto Jensen is local manager. C.

MINNEAPOLIS, MINN.—The City Clerk will call for bids for the installation of ornamental light posts in the Bridge Square district. C.

LAWNDALE, CAL.—The Southern California Edison Company is installing an electric lighting system at Lawndale, near Los Angeles. A.

IDAHO SPRINGS, COLO.—The Dorrit mine is said to be planning for the erection of an electric power plant. F. L. Patrick is manager. A.

POMONA, CAL.—Property owners of this town are planning to install a street lighting system on certain of the principal streets.

GLENDALE, CAL.—The Board of Trustees has ordered the installation of a street lighting system for the principal streets of this town.

CASTLEROCK, WASH.—The city has leased the electric lighting plant of the Castlerock Electric Company, and will operate it as a municipal plant. A.

WOODVILLE, ORE.—The Rogue River Electric Company has been given the contract for installing an electric lighting plant in this town.

PILOT MOUND, IOWA.—The Twogood Construction Company was granted a franchise to establish and maintain a light and power plant. . C.

PLUMMER, MINN.—The Battery Company of Milwaukee seeks a franchise to put an electric light plant, using the water power on Clearwater River. C.

HAILEY, IDAHO.—The Kirkpatric Brothers have plans under way for installing a power plant on Silver Creek to furnish light and power to Picabe.

ENFIELD, N. C.—This town will receive proposals until December 6, for the purchase of $10,000 six-per-cent twenty-year electric light system bonds.

WILLOWS, CAL.—The Sacramento Valley Power Company announces that it has bought the People's Power Company and is to come into Glenn County.

SUTTER CREEK, CAL.—The Pacific Gas & Electric Company is building a transmission line from its substation to the Poundstone mine, east of the city. A.

MAYNARD, IOWA.—At a special election held for the purpose of voting bonds for $5,000 for the construction of an electric light plan, the proposition carried. C.

GOLDENDALE, WASH.—The Pacific Light & Power Company has completed a five-mile extension of the line and Centerville is now supplied with electric lights.

BEDFORD, IOWA.—Electroliers will be placed on Main Street, Court Avenue, and Court Square. Twenty-four electroliers with five lights each have been purchased. C.

RENO, NEV.—The Nevada Valleys Power Company has been incorporated for $2,500,000 by Milton Hamilton and F. J. Early of Oakland, Cal., and their associates.

PINE CITY, MINN.—The Eastern Minnesota Power Company is extending power wires to Brahm, Grassbon, Mora, North Branch, Harris, Princeton, Grandy and Isanti. C.

EAGLE LAKE, MINN.—The Consumers' Power Company will make a proposition to furnish power and light to this village, extending cables from the dam at Rapidam. C.

GEORGETOWN, TEX.—The city is spending $50,000 in the betterment of the water and light plant. An increased water supply has been developed by sinking a well. D.

WINNER, S. D.—B. H. Martin of Dallas has asked for a twenty-year franchise for an electric light plant. The proposition was referred to a committee for consideration.

LINDSAY, CAL.—The Street Committee is making arrangements with the Mt. Whitney Light & Power Company for the installation of a new street lighting system. A.

PORTLAND, ORE.—The Ladd Estate Company will install an ornamental cluster lighting system on the new concrete viaduct to be constructed in the Eastmoreland District. A.

PORT TOWNSEND, WASH.—The Olympic Power Company has been granted a franchise for a transmission line from its power plant in Clallam County to this city.

COLUMBUS JUNCTION, IOWA.—Proposition to grant a franchise to E. N. Miller to build an electric light and heating plant will be submitted to the voters on November 28. C.

DALLAS, TEX.—The Hancock Electric Company has been formed here with a capital stock of $6,000. The incorporators are W. L. Hancock, Abe Hyman and J. B. Adoue, Jr. D.

GRIMES, CAL.—The Pacific Gas & Electric Company will install an electric lighting system at Grimes. The company will construct a transmission line to the city from Meridan. A.

TULARE, CAL.—The Tulare County Power Company has been granted an electric light and power franchise in Tulare County, by the Board of Supervisors, for a consideration of $100. A.

MILWAUKEE, WIS.—The Council Street Lights Committee has decided to purchase the equipment for a municipal lighting plant before commencing the erection of the building. C.

RED BLUFF, CAL.—The Sacramento Valley Power Company has commenced the construction of a line from the Cofer district to Jelly's Ferry, to furnish power for dredging operation. A.

CLARA CITY, MINN.—H. Schmidt of the Peterson-Retum Electric Lighting & Battery System, of Dawson, Minn., has asked for a franchise to install an electric light and power plant. C.

HUMBOLDT, IOWA.—The Northern Power Company will rush work on its power building, which will be of steel, cement and stone, in order to utilize power from the new dam this winter. C.

OROVILLE, CAL.—The present plant of the Oro Electric Company are to begin active construction work at Humbug early in the spring. The first work will be done on Yellow Creek.

WHITE SALMON, WASH.—The Northwestern Electric Company will build a power dam in the gorge of the narrows of White Salmon River. The dam will be of concrete and 175 feet high. C.

MANCHESTER, IOWA.—Work on rebuilding the Hoag light plant, which was destroyed by fire, will commence at once. Work will be completed and machinery installed about December 15. C.

WOONSOCKET, S. D.—The Schuler Electric Company seeks a franchise for an electric light plant, which will be granted, and a plant is being installed. It will be completed about January 1. C.

GROVELAND, CAL.—The Slap Jack mine will construct a power line from the Gold Ship mining district to its properties. An electric hoist will be installed. Richard Pierce is superintendent.

ANETA, N. D.—A franchise has been granted to the Aneta Light & Power Company, to erect a plant and to put up poles and string wires for the purpose of lighting the city with electricity.

VALDEZ, ALASKA.—The Gold Bullion Mining Company contemplates the erection of an electric power plant, to serve the mining interests in this district William Bartholf is superintendent

STOCKTON, CAL.—At an election, the citizens have approved of the installation of a municipal electrolier street-lighting system, with underground conduits. The work is estimated to cost $50,000.

TROPICO, CAL.—E. S. Ayres, Los Angeles, Cal., has submitted a proposal to the Town Council for the installation of an electric lighting system. The Council is said to be planning to accept the offer. A.

NEW BALTIMORE, PA.—An electric light plant has been installed by Norman Tupper who is proprietor of the grist mill. Free service will be given to the city until the beginning of the year.

ANDERSON, IND.—The Board of Public Works and the merchants are planning to install on all streets in the business section of the city a complete ornamental system of cluster lights. S.

MORTON, MINN.—The Wherland Electric Company of Redwood Falls, has been granted a franchise to furnish light at Franklin, and contemplates extending its lines to this city in the spring. C.

DIXIE, IDAHO.—The Idaho Realty, Power & Mines Company plans for the erection of an electric power plant at Dixie, with a distributing system to its mining properties. S. R. Gayton is manager. A.

TOWER, MINN.—The city is installing a dam for developing electric power for lighting, on Pike River. H. L. Bartlett & Company, of Virginia, Minn., have the contract and the work is well under way. C.

FRESNO, CAL.—The Pacific Light & Power Company has been granted a franchise for a transmission line along the foothills of Fresno, Kern and Tulare Counties, and through the Tejon Pass to Los Angeles.

DORRIS, CAL.—The Board of Town Trustees has awarded a contract to the Dorris Hardware Company for the construction of a waterworks and supply system. Electric pumping machinery will be installed. A.

TAFT, CAL.—The San Joaquin Light & Power Company nas signed contracts with the Maricopa Queen Oil Company, and the Eagle Creek Oil Company, for the installation of electric light and power on their leases. A.

SACRAMENTO, CAL.—The Sierra Electric Power Company has been incorporated by Charles Gross, J. E. Howes, E. A. Herman, H. G. Breed and M. S. Hamilton of Oakland, Cal., with capital stock of $3,000,000.

VALLEJO, CAL.—The work of laying the foundation for the new power plant on Mare Island has been started. It is estimated that an expenditure of about $15,000 will be necessary for the completion of the work.

WINNEMUCCA, NEV.—The County Commissioners have engaged Burns & McDonnell, engineers, Kansas City, to prepare estimates of cost of the installation of an electric lighting and water system at Winnemucca. A.

MONTESANO, WASH.—The Montesano Light & Power Company has commenced the erection of a new power plant near the city. The installation will comprise a Pelton-Francis turbine, and Westinghouse generator. A.

NYSSA, ORE.—The Idaho-Oregon Power Company has been granted an electric light and power franchise at Nyssa. The company plans for the construction of a transmission line from Boise to Weiser, Ida., via Nyssa. A.

MODESTO, CAL.—The Western States Gas & Electric Company is to build a power line from Stockton to Modesto in competition with the Sierra and San Francisco Power Company which recently entered Stockton.

WONDER, NEV.—The Hydro Electric Company will build a power line from the Nevada Wonder Mining District, to its new substation at the Jack Pot mine. The Jack Pot mine will install electric hoisting machinery. A.

COALINGA, CAL.—The Coalinga Water & Electric Company plans for the construction of a power line from the Good Luck district to the Pleasant Valley section, to supply electric power for pumping and irrigation work. A.

BRYAN, TEX.—The new lighting system on Main Street has been completed and lights turned on. The system includes con-

crete poles fourteen feet in height, each being equipped with five seventy-two-candlepower tungsten lamps.

BRAWLEY, CAL.—The Bernice Water Company, recently incorporated with a capital of $450,000, has filed on 50,000 inches of water in the Alamo River, and plans for the erection of a hydroelectric power plant. W. H. Best is president. A.

DORRIS, CAL.—The Siskiyou Electric Light & Power Company has been granted a fifty-year electric lighting and power franchise at Dorris. The company has deposited a bond of $500 to guarantee the fulfillment of the ordinance. A.

WICKENBURG, ARIZ.—The Big Blue Mining Company plans for the installation of a hydroelectric power plant on the Hassayampa River. A transmission system will be constructed to serve other properties in the district. R. H. Browne is manager. A.

ESCONDIDO, CAL.—The electric and gas installation department of the Escondido Utilities Company, has been acquired by Speer & Regan. The company will install all work from the property line, and the Utilities company will supply the service. A.

YERINGTON, NEV.—The municipal bond issue of $36,000 for the installation of a waterworks system at Yerington, has been purchased by the American Light & Water Company, Chicago. The company agrees to construct the system at a cost of $31,940.

CORYDON, IOWA.—J. J. C. Bower, City Clerk, will receive bids until December 5 for reconstruction of the electric light plant, comprising boilers, engine, generators and electrical apparatus. The Iowa Engineering Company, of Clinton, is doing the engineering work. C.

SAN FRANCISCO, CAL.—At a recent meeting of the stockholders of the Great Western Power Company, the capitalization was increased from $25,000,000 to $27,500,000 in order to complete the deal by which this company takes over the City Electric Company.

TUCSON, ARIZ.—The Great Western Power Company will soon commence active work on the construction of its proposed dam, and hydroelectric power plant in the Sabino Canyon. The work is estimated to cost $1,000,000, including a transmission system throughout the district. A.

THIEF RIVER FALLS, MINN.—The Northwestern Electric Equipment Company was awarded the contract for the total lighting equipment of the new auxiliary electric lighting plant, including two 225-horsepower Diesel Crude Oil Engines, and two 150-kilowatt Triumph generators. C.

DULUTH, MINN.—A favorable report has been made by C. E. McMillan on the waterpower situation in the Mesaba district and the Mesaba Range Power Company will install a plant which is of sufficient capacity to supply energy to the Mesaba Range towns and cities and several mines.

LOS ANGELES, CAL.—The Pacific Light & Power Company has authorized a bond issue of $35,000,000. Of this amount $9,000,000 will be set aside to guarantee the underlying bonds and the remainder will be used for construction of the Big Creek power project in the San Joaquin Valley.

HONOLULU, T. H.—The Island Investment Company has awarded a large contract to the Hamm-Young Company for machinery for a steam electric plant which the Island Investment Company is building between Wailuku and Kahului on Maui, to supply these towns with light and power.

OTTERBEIN, IND.—The Otterbein Light & Power Company has incorporated with a capital stock of $10,000. The company proposes to build, equip and operate a public service plant to furnish electric current for light, heat and power. The directors are R. H. Holt, Lewis Leaming and R. W. Pearce. S.

HARLINGEN, TEX.—The City Council will soon begin the installation of a waterworks plant and distributing system and an electric light and power plant. Bonds for these proposed improvements have been issued. The work of construction will be superintended by the firm of Randall, Lovegrove and Wyman of Houston.

VENICE, CAL.—The city plans for the installation of an ornamental street-lighting system with concrete posts. The city will manufacture the posts, which will be of special design, and will sell them to property owners at cost, estimated at $9.00 each. The city will furnish light free of direct charge. City-Engineer Lewis is in charge. A.

POCAHONTAS, IOWA.—The Dwyer-Field Company, of St. Paul, was awarded the contract for the electric light plant construction at $11,800. The engine purchased is a seventy-horsepower De la Vergne oil engine. The building will be 30 by 34 feet, one story. The Oscar Claussen Engineering Company, St. Paul, is the engineering firm employed. C.

GRANTS PASS, ORE.—M. J. Anderson, and associates, plan for the erection of a hydroelectric power plant on the South Fork of the Coquille River. A transmission and distributing system will be constructed to serve industrial interests throughout the district. The plant will have a capacity of 25,000 horsepower, and is estimated to cost $1,000,000. A.

FRESNO, CAL.—The Pacific Light & Power Company, Los Angeles, has been granted a fifty-year electric pole line franchise in certain sections of Fresno County, for a consideration of $100. The company plans for the construction of a transmission line to Los Angeles, from its proposed Big Creek power plant in the Sierra Forest Reserve, near Shaver. A.

MICHIGAN CITY, IND.—The Haskell & Barker Car Company, which has a large car-manufacturing plant here, has ordered from the General Electric Company one motor-generator set, ninety-seven induction motors, and a switchboard. This company is remodelling its electrical equipment and changing from alternating-current to direct-current motor drive.

RENO, NEV.—The Nevada Valley Power Company has been incorporated with a capital of $2,500,000 to build a 4,000-horsepower hydroelectric power plant on the Truckee River, near Reno, with a transmission system to surrounding territory. A. D. Ayers, H. D. Danforth and A. A. Smith, of Reno, and M. S. Hamilton and J. F. Early, of Oakland, Cal., are incorporators. A.

POMONA, CAL.—The Southern California Edison Company will rebuild its street-lighting system at Pomona. The present incandescent system will be changed to a tungsten circuit throughout the residential district. Twenty-six arc lamps will be installed in the business district, and a mercury-arc rectifier installed in the local substation to provide for the street arcs. A.

ATLANTA, GA.—The Appalachian Power Company, of which Louis B. Magid of Atlanta is president, is changing its name to the Appalachian Electric Power Company and now has engineers investigating five properties in North Georgia to determine on plans for developments. The company will furnish electricity to Toccoa, Ga., and Walhalla, Seneca and Westminster, S. C.

TUCSON, ARIZ.—The Federal Power & Water Company has filed notice with the County Recorder of the appropriation of 10,000 cubic feet of water in the Sabino Canyon, and 5,000 cubic feet of water in the Bear Canyon. The company will install a hydroelectric power plant at the junction of the two canyons. A transmission and distributing system will be constructed, and electric power delivered for commercial use. H. W. Roche is president.

LOS ANGELES, CAL.—The Pacific Light & Power Corporation has filed notice with the County Clerk of the issuance of bonds for $35,000,000. Underlying bonds amounting to $9,000,000, and underlying bonds of the Southern California Gas Company, controlled by the corporation, are taken up in the new issue, the balance to be used in improvements and extensions to the company's distributing system, and for the construction of the proposed hydroelectric power plant on Big Creek, San Joaquin Valley. A.

WALLACE, IDAHO.—The Long Valley Light & Power Company, incorporated with a capital of $100,000, plans for the erection of a hydroelectric power plant on Van Wyck Falls, near Crawford, with a total generating capacity of 4,365 horsepower. A transmission and distibuting system will be constructed to supply Rosebury, Crawford Lardo, McCall, Van Wyck and Thunder City. The company also plans for the installation of waterworks systems, with electric pumping machinery. Walter C. Clark is president.

DALLAS, TEX.—The Dallas Electric Light & Power Company will nearly double the capacity of its power plant here. The present capacity of the plant is 5,800 kilowatts. With the installation of additional machinery 5,000 kilowatts will be added. Power from this plant is used to operate the street railway system in Dallas, these properties being owned by the Stone & Webster Engineering Corporation of Boston. The same interests own the interurban line that runs between Dallas and Fort Worth and between Dallas and Sherman. It is stated that improvements to the local street railway system will be made. Recently a substation was erected near the Trinity River in the suburbs of Dallas by the Stone-Webster interests. D.

BEAUMONT, TEX.—Interests identified with the Stone & Webster Engineering Corporation, of Boston, Mass., which have acquired the local electric power and light plant here, have just organized the Beaumont Electric Light & Power Company with a capital stock of $880,000. The incorporators are: C. W. Kellogg, of Dallas; Marshall M. Phinney, of Boston; E. J. Emerson, of Beaumont; L. C. Bradley, of Galveston; David Daly, Harry L. Harding and W. A. Stevens, of Houston. The new company, in addition to making extensive enlargements and improvements to the plant, will, it is reported, construct an electric railway between Beaumont and Port Arthur. The report as to the plans for the latter project, however, lacks official confirmation. D.

SUPERIOR, WIS.—The contract for the erection of the Superior power station of the Great Northern Power Company has been let to Emil Sadlachek of this city. Work on the new station will start at once. It will be finished in three months, but will not be ready for use until next summer owing to the large amount of heavy machinery which will be installed. It will have a ground area of sixty by forty feet, and will be fifty feet high. The right of way for the new transmission line from the Great Northern Power Company's hydraulic power plant at the dam across the St. Louis River near Thomson has been secured. This line will run along the Wisconsin side of the St. Louis River, following the Northern Pacific Railroad out of Superior to the old townsite of St. Louis, from where it will continue along the south side of the river to the power dam. Clearing work will be started this winter, but actual construction operations will not start until next spring.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SANTA ANA, CAL.—The Pacific Electric Railway Company will soon commence the construction of a line from La Habra to Newport, by way of Fullerton, Anaheim, and Santa Ana. A.

OAKLAND, CAL.—The Oakland, Antioch & Eastern Railway has executed a $5,000,000 mortgage in favor of the Union Trust Company, San Francisco, for the purpose of providing funds for new construction work. A.

RICHMOND, IND.—A route from Connersville through Richmond and Liberty to Cincinnati has been selected by the officials of the Richmond & Eastern Indiana Traction Company, which proposes to build a heavy traffic line into Cincinnati. W. J. Jordon is secretary. S.

NOBLESVILLE, IND.—Wallace Campbell, of Anderson, has revived the project of building an interurban line to connect Anderson, Noblesville, Lebanon and Crawfordsville. Mr. Campbell is securing the extension of franchises and rights of way very readily which were granted three years ago. S.

EVANSVILLE, IND.—Elections held November 6 in Hart and Boone Townships, Warrick County, to vote a subsidy tax in aid of the construction of the Evansville and Booneville traction line were carried in both townships by large majorities. The survey of the lines has been completed and work on the road will commence soon. S.

COSHOCTON, O.—This city, the largest town in Ohio that has been without a street railway up to the present time, will in the near future have a street car system five miles long. The work will be started in the spring. Frank A. McGowan, of Canton, is promoting the enterprise. The Edison-Beach storage battery system will be used. H.

CLEVELAND, O.—The recent election resulted in the carrying of the proposed amendment of the Taylor grant under which the Cleveland Electric Railway is operating. The company has announced that it contemplates making the improvements called for in this amendment at an early date. New rolling stock and additional power will be necessary in order to care for the existing traffic.

VANCOUVER, WASH.—Papers are being prepared for filing by the General Development Company for the incorporation of the Washington Trunk Railway, with a capital stock of $5,000,000. The subsidiary company is organized for the purpose of constructing an electric railway from Vancouver to North Yakima, and to Ellensburg. A line is also planned from Vancouver to Portland, Ore. A.

RISING SUN, IND.—Chicago and New York capitalists are promoting a high-speed interurban line to connect this city with Aurora, a distance of nine miles. The plan is ultimately to extend the line east from Aurora to Cincinnati and thence west from Rising Sun to Louisville. Raymond Zeitler, an experienced railroad promoter of Chicago, is on the ground to stay until the line is constructed. S.

LAPORTE, IND.—The New York Air Line Railway Company has filed a mortgage in the city for $100,000 in favor of the Baltimore Trust Company. Engineers are completing the surveys preparatory to completion of the road. Officials of the road announce that traffic arrangements have been made which will insure the running of the Northern Indiana cars from Goshen through to Laporte and Hammond. S.

TERRE HAUTE, IND.—The City Council has directed the city attorney to bring suit against the Terre Haute, Indianapolis & Eastern Traction Company to enforce compliance with a recent ordinance requiring the installation of new fenders of the most improved type on all the city cars. The answer of the company that the fenders now in use were of the best type and the kind used in nearly all cities was deemed insufficient. S.

NEW HAVEN, CONN.—The Shore Line Electric Railway Company has completed its new line into New Haven from Guilford by way of Foxon and North Branford and will soon open it for traffic. The company will operate express cars on a fast schedule between New Haven, using the tracks of the Connecticut company within the city, and the Connecticut River towns via this route, and its line between Guilford and Stony Creek, connecting with the Connecticut company's Branford line, will be operated as a branch

DURANGO, MEX.—Negotiations for the sale of the local street railway system to a syndicate of Americans, represented by T. W. Ward of Kansas City, Mo., have been in progress for some time. The present owners are Mexicans. The system extends to all parts of the city and upon the principal business and residence streets. It is planned by the prospective American purchasers to convert the lines into electric traction and construct important extensions. The city has a population of about 50,000 and is an industrial center of importance. D.

SAN ANTONIO, TEX.—Engineers and other representatives of the Stone & Webster Engineering Corporation of Boston, Mass., have been investigating the situation in San Antonio and between this city and Austin with the view to constructing an interurban electric railway between the two cities. The distance is eighty-one miles. There are several prosperous towns of considerable size on the route, among them being San Marcos, New Braunfels, Kyle, Buda, Hunter and Manchaca. The country is thickly populated and it is stated that the territory affords an inviting field for interurban-railway operations. It is reported that the same interests are also negotiating for the purchase of the electric street railway systems in San Antonio and Austin. D.

PACHUCA, MEX.—The Pachuca Railway Company which is constructing an electric railway from this city to the Real del Monte mining district will soon have the line finished. It will be about twelve miles long and in some respects is an interesting and unique piece of engineering work, owing to the rough character of the country. The company has adopted plans for extensive enlargement of its hydroelectric plant and service. It is already furnishing 1,500 horsepower for mines and industries, and this is to be brought up to about 7,500 horsepower. It has applied for concessions from the Government for the construction of three large dams which will afford a water-storage capacity sufficient to generate the additional power that is required. Transmission lines will be constructed to the different mines and outlying industrial plants. The headquarters of the company are at Tepeji del Rio, in the Tula district of this state. It is expected that the introduction of cheap electric power into the mining camps will greatly stimulate development operations of the mines. D.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

BELFIELD, N. D.—The Belfield & Northwestern Telephone Company has been granted a franchise.

FREMONT, NEB.—The Nebraska Telephone Company will erect a telephone building to cost $60,000. C.

GENTRY, ARK.—The Mt. Zion Mutual Telephone Company has been granted a ten-year franchise here.

CARLTON, ORE.—The Carlton Mutual Telephone Company has been granted a ten-year franchise in Carlton.

DULUTH, MINN.—The Board of Fire Commissioners have asked for the installation of a new alarm system. C.

FLORESVILLE, TEX.—A. J. Moore has let the contract for the erection of a telephone exchange here for the Eureka Telephone Company.

CLEAR LAKE, IOWA.—The telephone company has reincorporated and has raised the amount of its capital stock from $10,000 to $40,000. C.

MASON CITY, IOWA.—The Clear Lake Telephone Company has reincorporated and has raised the amount of its capital stock from $10,000 to $40,000.

ARCATA, CAL.—J. H. Blake, proprietor of the Independent Telephone line, is preparing to extend this line to the mouth of Mad River for the benefit of the ranchers along the way.

BAKERSFIELD, CAL.—The Delano-Linn Valley Telephone Company, recently organized, will install a telephone system from Delano to Linn Valley. Benjamin Thomas is president. A.

WATERLOO, IOWA.—The Corn Belt Telephone Company has let the contract to James Maine & Sons for a central exchange office, with alterations to the present building and a new steam heating plant. C.

ELKHART, TEX.—The Farmers Union Telephone Company has been formed here for the purpose of installing a local exchange and constructing lines to a number of towns in this section. Ben G. Parker is president. D.

CONCORD, CAL.—The Mt. Diablo Telephone Company has been incorporated by H. C. Wetmore of Concord, Joseph F. Frank and Charles Gordon of Clayton. The line will be run through Concord to the Ygnacio Valley and Clayton.

PASADENA, CAL.—The Pacific Telephone & Telegraph Company is planning extensive improvements to the system in Pasadena and will erect a two-story, fireproof office building if the City Council grants the desired franchise.

ASTORIA, ORE.—The Centennial Telephone Company, recently organized, has been granted a franchise to install a telephone system from Astoria to the Nehalem Valley. Contract for labor is said to have been awarded to Damon Stinson.

EL CENTRO, CAL.—The Imperial Valley Telephone Company plans for the erection of a new central station at El Centro. The company has recently inaugurated twenty-four hour service throughout the valley towns. J. F. Bezdecheck is manager. A.

PORT LAVACA, TEX.—The Port Lavaca Telephone Company is reconstructing its system in this place. Besides rebuilding the lines it is installing new switchboards. The company also operates long-distance lines to many towns in Calhoun and Victoria Counties. This system will be extended and improved. D.

RED BLUFF, CAL.—The Pacific Telephone & Telegraph Company is building a new line from Red Bluff to Paskenta, via Lowrey. The company has acquired the private telephone system extending from Red Bluff to Rawson Switch, on the Southern Pacific Railroad. The line will be improved, and extended to neighboring districts.

ELECTRICAL SECURITIES.

Harris, Forbes & Company, of New York, N. W. Harris & Company, of Boston, and Harris Trust and Savings Bank, of Chicago, have purchased, and are offering to investors, $10,445,000 Montreal Tramways Company first and refunding mortgage five per cent. bonds. The proceeds will provide the company with funds in connection with the purchase of the property of the Montreal Street Railway Company and retirement of part of the latter company's bonds.

Stockholders of the Detroit Edison Company, at a special meeting, ratified the proposal to increase the capital stock of the company from $9,000,000 to $15,000,000. Of the $9,000,000 stock, $6,000,000 is outstanding and $3,000,000 is reserved against a like amount of outstanding convertible debenture bonds. It is proposed to issue at an early date $1,500,000 of the new stock.

There has been placed on the regular list in the Philadelphia Stock Exchange $37,678,500 additional capital stock of the American Telephone & Telegraph Company, issued as follows: $178,500 in exchange for $226,000 convertible bonds of the company, cancelled, and $37,500,000 being part of $55,086,500 offered in circular letter, dated June 30, 1911, to stockholders. This makes the total amount of capital stock of the American Telephone & Telegraph Company listed at this date $313,788,100 and reduces the amount of convertible bonds of the company outstanding $21,648,000.

DIVIDENDS.

American Railways Company; regular quarterly dividend of one and one-half per cent, payable December 15, to stock of record November 30.

Chicago Elevated Railways; a quarterly dividend of one and one-half per cent on the preferred participation shares, payable December 1 to stock of record November 25.

Cities Service Company; regular monthly dividends of one-half of one per cent on the preferred and one-quarter of one per cent on the common stock, payable December 1, to stock of record November 20.

General Electric Company; regular quarterly dividend of two per cent, payable January 15 to stock of record December 2.

Norfolk Railway & Light Company; declared a regular semi-annual dividend of two and one-half per cent, payable December 8 to stock of record November 30.

Philadelphia Electric Company; regular quarterly dividend of one and one-half per cent, payable December 15 to stock of record November 21.

Rochester Railway & Light Company; quarterly preferred dividend of one and one-quarter per cent, payable December 1 to stock of record November 23.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Nov. 20.	Nov. 13.
Allis-Chalmers common	$	$
Allis-Chalmers preferred	14½	12
Amalgamated Copper	61¼	59½
American Tel. & Cable	*74	*74
American Tel. & Tel.	138¾	140¼
Brooklyn Rapid Transit	77¾	78
General Electric	154	153½
Interborough-Metropolitan common	15½	14½
Interborough-Metropolitan preferred	47⅛	44¾
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	83	84
Mackay Companies (Postal Telegraph and Cables) preferred	72¾	73
Manhattan Elevated	134	135
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	47½	48
U. S. Steel common	64	63⅝
U. S. Steel preferred	109¼	109¾
Western Union	77¾	78¾
Westinghouse common	66	65¾
Westinghouse preferred	*114	114

*Last price quoted.

BOSTON.

	Nov. 20.	Nov. 13.
American Tel. & Tel.	138¾	140
Edison Elec. Illuminating	290	288
General Electric	154	153½
Massachusetts Electric common	21½	21¼
Massachusetts Electric preferred	94	93½
New England Telephone	149	147

PHILADELPHIA.

	Nov. 20.	Nov. 13.
American Railways	46½	44¼
Electric Company of America	11⅞	11⅞
Electric Storage Battery common	53¼	53¼
Electric Storage Battery preferred	53¼	53¼
Philadelphia Electric	16	16½
Philadelphia Rapid Transit	23½	23½
Philadelphia Traction	84	84½
Union Traction	51⅝	52¼

CHICAGO.

	Nov. 20.	Nov. 13.
Chicago Elevated Railways, common	28¼	28½
Chicago Elevated Railways, preferred	94¼	93
Chicago Railways, Series 1	95	95
Chicago Railways, Series 2	32½	33
Chicago Subway	⅜	½
Chicago Telephone	123	122½
Commonwealth Edison	134¼	132
National Carbon common	102½	104
National Carbon preferred	118	118

PERSONAL MENTION.

EDWARD J. NALLY, first vice-president and general manager of the Postal Telegraph-Cable Company, is now in San Francisco.

H. L. WALTHERS, formerly manager of the Yreka Railroad, is now manager of the Siskiyou Electric Power & Light Company and its subsidiaries.

MORGAN JONES, assistant superintendent of transportation for the Indiana Union Traction Company, has been promoted to the division superintendency of the Indianapolis, Logansport and Peru division, with headquarters at Tipton, Ind.

CHARLES A. OSBORN, JR., district traffic chief of the Iowa Telephone Company, at Dubuque, Iowa, has formally announced his engagement to Miss Kathryn Louise Newton, of Lamont, Iowa. The wedding will take place early in January, after which the couple will reside in Dubuque.

J. F. STEVENS, president of the Keystone Electrical Instrument Company, of Philadelphia, Pa., has resigned, at the same time selling his interest in the firm. Mr. Stevens will devote his time in the future to consulting electrical engineering work, and has opened an office in the Hale Building, Philadelphia.

THEODORE N. VAIL, president of the American Telephone & Telegraph Company, and Charles S. Gleed, president of the Missouri-Kansas Telephone Company, are stopping at Los Angeles, Cal. It is reported that Mr. Vail's visit is in connection with a consolidation of the two telephone companies at Los Angeles.

JENS BACHE WIIG, who has had charge of the alternating-current generator and rotary-converter design of the Westinghouse Electric & Manufacturing Company, has been appointed professor of electrical engineering at the Norwegian Technical University, Trondhjem, Norway. Mr. Wiig's appointment takes effect January 1, 1912.

FREDERICK B. EAVES has accepted a position on the commercial staff of the Bryant Electric Company, of Bridgeport, Conn. Mr. Eaves has had valuable experience with Stone & Webster and the Boston Edison Company and more recently with E. R. Ham, of Worcester, Mass., and in the work which has been allotted to him of representing his new principal in New England and New York State his efforts should show gratifying results.

GLENN C. WEBSTER, manager of the engineering department of the National Electric Lamp Association, Cleveland, started Friday, November 17, on an extended western trip. On Friday afternoon he gave an address on the value of co-operation in modern business enterprises at the banquet at the National Cloak and Skirt Manufacturers' Association, at Toledo. He is now on his way to Los Angeles, where he will have general oversight of the National Electric Lamp Association's exhibit at the Electrical Exposition. Mr. Webster expects to make a study of industrial conditions in San Francisco and other coast cities, returning to Cleveland late in December.

PHILIP S. DODD, director of publicity of the National Electric Lamp Association, has just returned from an extended trip to the Pacific Coast, made in behalf of the Commercial Section of the National Electric Light Association. Mr. Dodd is secretary of the Commercial Section, and has met with a most enthusiastic response all through the western country in working out a comprehensive plan for handling the work of the various committees. The trip has been made with the particular idea in mind of meeting the necessities of the commercial man's problems in every section of the country. Mr. Dodd left Chicago on October 12, and visited in turn Denver, Salt Lake City, Reno, San Francisco, Portland and Seattle, returning through San Francisco, Reno, Denver, Minneapolis and Chicago. Following the Jovian convention at Denver, Mr. Dodd was appointed National Statesman of that order. In Seattle, in conjunction with H. M. Winters, the energetic manager of the sales department of the Seattle Electric Company, a lunch club was formed to effect a co-operation of the electrical interests of the city, to devise ways and means for assisting the local committee in the entertainment of the delegates to the Seattle Convention of the National Electric Light Association, to promote the work of the Commercial Section in that part of the country, and to work toward the introduction of a co-operative electrical page similar to that conducted by the electrical interests in other parts of the country. At San Francisco, Mr. Dodd was given a complimentary luncheon by John F. Britton, T. E. Bibbins, and E, B. Strong. On this occasion Mr. Dodd described the work of the Commercial Section. He referred incidentally to the value of co-operative effort in various sections of the country and emphasized the very satisfactory results which had followed the introduction of the "Co-operative Electrical Page" in other cities. Mr. Britton and Mr. Bibbins warmly indorsed Mr. Dodd's suggestions, and promised their support. Mr. Britton spoke very forcibly respecting the great value of the spirit of co-operation and fraternity among the electrical contractors and the central-station. A lunch club was also formed at San Francisco to carry on a work similar to that indicated in the case of Seattle. Mr. Dodd will stay for a short time in Cleveland, and will then go to New York to organize the central bureau of the Commercial Section, and on December 1 will open an office at 29 West Thirty-nineth Street, where the work will be carried on in close connection with the office of Secretary Martin.

OBITUARY.

STEPHEN LINDECK, an official of the physico-technical government institution at Charlottenburg, Germany, died on October 21. He was also editor of the *Zeitschrift fur Instrumentenkunde*. He has been connected with the *Reichsanstalt* since its founding in 1887, and had charge of the testing of electrical instruments. He did much valuable work in connection with electrical standards, especially in the measurement of resistance and electromotive force.

GEORGE W. HEBARD, acting vice-president of the Westinghouse Electric & Manufacturing Company, died at his home in New York City on Friday, November 17. Mr. Hebard was born in Barre Center, Olean County, New York, in 1845, and was sixty-five years of age. He had been in poor health for some time previous to his death. Besides his active participation in his chosen profession, Mr. Hebard was also very active in social, religious and philanthropic work in New York. He was a member of the Tompkins Avenue Congregational Church; having been superintendent of the Sunday School for some time. He was a man of genial disposition, keen judgment and a business man with a wonderful grasp of affairs. He was a member of the Union League, the Lawyers', Engineers' and several other clubs. Mr. Hebard leaves, residing in New York, a wife and two children, Charles R., engaged in the cotton business; Arthur, engaged in the ammunition business, in which his father was engaged prior to entering the electrical profession. Mr. Hebard was sole executor of the Marcellus Hartley estate, which owned the Union Metallic Cartridge Company and the Remington Arms Company, all which he settled in a most satisfactory manner to all concerned. The death of Mr. Hebard has removed from the electrical profession one of the pioneers of this industry. He was identified with the early history of the manufacture of electrical apparatus, becoming president of the United States Electric Lighting Company of Newark in 1882, and had associated with him, as directors, Marcellus Hartley, Anson Phelps Stokes, Charles R. Flint, Henry B. Hyde, Charles F. Brooker, Leonard E. Curtis and other well known men. Mr. Hebard was connected with the early history of the generation and distribution of electric lighting in New York City as a director and stockholder of the United States Illuminating Company. In this position he had to do with the equipment of the Weston lighting system on Brooklyn Bridge, parts of which are still in service. Later, as president of the United Electric Light & Power Company, he was closely affiliated with the introduction of the Westinghouse alternating-current system in New York City by means of the overhead system. He was later active in the change of the distribution system from the overhead to underground. The improvement of the system of distribution from the standpoint of the manufacturers of the current was also one of his most successful labors. At the time the United States Company was taken over by the Westinghouse Company, Mr. Hebard was president of the United Company, and in the reorganization was made vice-president of the Westinghouse Company, and, in 1888, when this company took over the Sawyer-Man Company, Mr. Hebard was given charge of the newly acquired organization. The funeral took place from Tompkins Avenue Church, Brooklyn, Monday, November 20.

GEORGE W. HEBARD.

PROPOSALS.

WIRING.—The office of the Supervising Architect, Washington, D. C., will receive bids until December 19, for installing heating apparatus, electric conduit, wiring and interior-lighting fixtures in the Post Office at Paragould, Ark. Drawings and specifications may be obtained from the custodian of site at Paragould, or from the Supervising Architect.

NAVAL SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will receive sealed bids on material as given below. Bids are to close on the dates indicated.

Date.	Material.	Delivery.	Schedule No.
Nov. 28—	Generators and spare parts..	Miscellaneous	4078
Nov. 28—	Wire, brass and copper.....	Miscellaneous	4076
Dec. 12—	Electric traveling crane.....	Mare Island, Cal	4071
Dec. 12—	Electric motor truck.....	Puget Sound, Wash.	4072
Dec. 5—	1,000 Leyden jars.....	Brooklyn, N. Y	4092
Dec. 12—	Traveling crane	Pearl Harbor, T. H	4082
Dec. 12—	Eight transformers and spark gaps	Brooklyn, N. Y	4084
Dec. 19—	1,500 pounds cotton-covered magnet wire	Mare Island, Cal	4099

Schedules may be obtained from the Navy pay office nearest each navy yard. In requesting schedules the number must be mentioned.

INDUSTRIAL ITEMS.

THE AMERICAN PLATINUM WORKS, Newark, N. J., announces that it has acquired the business of Croselmire & Ackor Company, of the same city.

THE INDIANA RUBBER & INSULATED WIRE COMPANY, Jonesboro, Ind., has prepared handsomely framed pictures of its manufacturing plant. The picture is 23 by 28 inches and is suitable for hanging.

LEIMAN BROTHERS, New York, N. Y., has mailed cards advertising its blowers and vacuum pumps. The blowers are made in eight sizes ranging in price from $17 upward. The pumps are made in seven sizes, from $21 up.

W. N. MATTHEWS & BROTHER, St. Louis, Mo., advertises the Matthews' easy lamp changer on a recent mailing card. With one of these changers, a lamp can be replaced inside of two minutes and the dangers that accompany the use of a step ladder are eliminated.

THE WESCO SUPPLY COMPANY, St. Louis, Mo., gives a number of interesting facts regarding St. Louis, in the November number of *The Red Shield*. The statement is made that the proportion of electrical goods made in St. Louis to those sold there is very rapidly increasing.

THE GEM MANUFACTURING COMPANY, Pittsburgh, Pa., illustrates its line of patented specialties in a recent catalog. The company's product consists principally of steel and brass oilers, although flue-cleaners, polishers, grinders, etc., are also supplied by this concern.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., calls attention in a recent booklet to a two-color advertisement which appears in the *Saturday Evening Post* of November 25. This advertisement occupies the two center pages and illustrates and describes a number of Hotpoint devices.

LAMB ELECTRIC COMPANY, Grand Rapids, Mich., has been appointed agent for the Independent Electric Manufacturing Company, of Milwaukee, for Grand Rapids and vicinity. The Lamb Company will carry in stock a complete line of Independent controllers and controlling devices for immediate shipment.

THE UNITED STATES ELECTRIC MANUFACTURING COMPANY, Los Angeles, Cal., has been appointed selling agent for Los Angeles and vicinity by the Independent Electric Manufacturing Company, of Milwaukee. The company will carry a complete stock of Independent controllers and controlling devices for immediate shipment.

THE TRIUMPH ELECTRIC COMPANY, of Cincinnati, O., has recently opened a district office at No. 2219 Farmers' Bank Building, Pittsburgh, Pa. Formerly this company was represented by the Doubleday-Hill Electric Company in that territory, but the rapidly increasing business made it seem advisable to have direct representation in this important center. D. D. Gill will be in charge of the new office.

THE WESTERN ELECTRIC COMPANY has received from the Chicago & Northwestern Railroad an order for apparatus to be used in extending its telephone-system train control. A total of twenty-eight Western Electric type selectors has been ordered and these are to be placed along the West Iowa division, extending from Boone to Council Bluffs, Iowa, a distance of approximately 150 miles. The dispatcher will be located at Boone.

THE PEERLESS ELECTRIC COMPANY, Warren, O., describes its motors and generators in Bulletin No. 33, which appeared a short time ago. Peerless machines are manufactured in both bipolar and multipolar types; the bipolar for small motors up to one horsepower and the multipolar for motors from one-quarter to thirty-five horsepower. Generators from twenty watts to 560 watts are designed in bipolar frames, and from 400 watts to 30 kilowatts in multipolar frames.

THE KERR TURBINE COMPANY, Wellsville, N. Y., has mailed its Bulletin No. 22 entitled "Be Ready for the Long Dark Nights." The subject matter concerns isolated lighting plants. The company's Bulletin No. 20 deals with the economy improvements and operating conveniences of Kerr turbo-blowers and turbo-pumps particularly in gas plant service. This bulletin contains interesting comparisons with other driving methods for the same work and illustrates a number of installations.

THE GENERAL ELECTRIC COMPANY has just placed on the market a new piece of apparatus known as a battery truck crane, which the company describes in its Bulletin No. 4892, recently issued. The machine is a short, heavy, storage-battery vehicle having mounted on its forward end a swinging crane, the hook of which is raised and lowered by a one-ton hoist operated from the vehicle battery. The vehicle is used in loading, hauling, and unloading trailers, loading and unloading cars, hoisting and carrying on the hook boxes or barrels, and for stacking. The running of the vehicle, hoisting and carrying, are controlled by one man. The crane is equipped with special attachments to suit the carrying on of the work contemplated, and the height can be made to suit local conditions. The bulletin contains illustrations of the truck and crane in use, and describes also various pieces of apparatus used in connection with it.

H. W. JOHNS-MANVILLE COMPANY, Cleveland, O., devotes the current number of *The J-M Roofing Salesman*, one of its two house organs, to pictures showing the many different classes of buildings covered with "The Everlasting Roofing." A particularly interesting full-page view is that of the buildings of the Republic Stamping & Enameling Company, of Canton, O., which has used J-M asbestos roofing on both flat and saw-tooth construction for now more than twelve years and has just contracted for another 600 squares for new buildings.

THE VALENTINE-CLARK COMPANY, Minneapolis, Minn., dealer in northern and western cedar poles, announces that it has opened a sales office at St. Maries, Idaho, and is now in position to quote prices on western cedar poles from this office to all points west of the Dakota-Montana line and points in the State of Colorado and west thereof, and also into Texas. Neil Burrell, formerly identified with this company in the East, has charge of the St. Maries office in connection with L. H. Clark, son of E. L. Clark, president of the company. The St. Maries office will be glad to receive inquiries from prospective buyers in the West.

THE HOSKINS MANUFACTURING COMPANY, Detroit, Mich., maker of the Hoskins electric furnace, pyrometers and heating appliances, has purchased the business of the International Electric Meter Company of Chicago. The manufacture of the International instruments will be continued by the Hoskins company at its Detroit plant, with the same production organization that during the past seven years has made the International a line of established merit. The International measuring instruments comprise ammeters and voltmeters of portable and switchboard types in a variety of designs for alternating and direct-current circuits.

THE REMY ELECTRIC COMPANY, Anderson, Ind., which recently absorbed the American Electric Headlight Company and now makes the American electric headlight for steam locomotives, has purchased outright all patents, designs, good will and manufacturing rights of the Peters electric headlight for steam locomotives. The locomotive headlight departments of the R. G. Peters Company, of Grand Rapids, Mich., have been moved to Anderson and the Peters light will be owned, manufactured and sold by the Remy Company. New buildings will be erected at the Anderson plant to care for the increased production of the Peters lighting apparatus. The Remy Company has taken over the leading men who were employed by the Peters Company in its headlight department.

THE MOHAWK ELECTRIC COMPANY, Albany, N. Y., and the St. John Corporation, New York City, have united under the name of the Mohawk Electric Company. The Mohawk Electric Company manufactures the Rollinson electrical specialties, and the St. John Corporation was the general distributer of these products. The new company is incorporated under the laws of New York, and after December 1 the main office and factory will be located at 64-66 Shipman Street, Newark, N. J., where double the capacity of the old Albany plant will be used in the manufacture of lamp-testing watt indicators, rectifying sets for charging storage batteries, toy transformers and other specialties. The following officers and directors have been elected: G. St. John, Jr., president; E. H. Rollinson, vice-president; A. W. Hogeland, treasurer; B. F. La Rue, financial secretary.

THE FEDERAL SIGN SYSTEM (ELECTRIC), Chicago, Ill., has issued a very complete bulletin covering the entire Federal line of fixtures, steel shades, lock-clamp sockets and bushings, and supplies. An interesting new line of porcelain-enameled steel fixtures is one of the features of the bulletin. They are well designed attractive looking fixtures that can be assembled in numerous combinations to suit every requirement of illumination either indoors or outdoors. The durability of these fixtures will make these moderate priced combinations especially desirable. A complete line of porcelain-enameled steel shades of new design is another feature of the bulletin. These shades are of concentrating or diffusing types that can be used to make a variety of effective steel units. A new low-priced line of art-glass portables, hall lights and pedestals occupies several pages. A reduction of 20 per cent is made in the prices of the No. 304 and No. 305 lock-clamp sockets, which are listed for the first time under the same cover with the fixture line. The bulletin as a whole makes a complete and handy catalogue for the fixture dealer, central station, salesman or any electrician interested in the subject of illumination.

DATES AHEAD.

Los Angeles Electrical Exposition. Los Angeles, Cal., November 25-December 9.

American Physical Society. Regular Thanksgiving meeting, Chicago, Ill., December 2, 1911.

National Gas and Gasoline Engine Trades Association. Annual meeting, Hotel Hollenden, Cleveland, O., December 5-8.

American Institute of Chemical Engineers. Annual meeting, New York City, December 5-8.

American Society of Mechanical Engineers. Annual meeting, Washington, D. C., December 20-22.

American Association for the Advancement of Science. Annual meeting, Washington, D. C., December 27-30.

Western Electrical Inspectors' Association. Milwaukee, Wis., January 23-25, 1912.

National Electric Light Association. Next annual convention, Seattle, Wash., June 10-14, 1912.

National Electrical Contractors' Association. Annual meeting, Denver, Colo. July 17-20, 1912.

The 1912 Boston Electric Show. Mechanics Building, Boston, Mass., September 28-October 26, 1912.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) November 14, 1911.

1,008,313. FIRE-ALARM SYSTEM FOR TELEPHONE EXCHANGES. William L. Denio, Rochester, N. Y. Filed Apr. 5, 1909. Bridged across the subscriber's line is a normally open fire-alarm circuit which when energized sets up visual and audible signals in the telephone exchange.

1,008,320. PULL-CHAIN GUIDE. Edgar H. Freeman, Trenton, N. J., assignor to E. H. Freeman Electric Co., Trenton, N. J. Filed June 21, 1911. A pull-chain guide for a lamp-socket switch comprises an inner fixed slotted member and an outer one-piece bell member detachably engaged with the slotted member and serving to open and close the slot.

1,008,326. ELECTRIC-CURRENT-SHUNTING DEVICE. Redman W. W. Grigsby, Los Angeles, Cal. Filed Oct. 24, 1910. An adjustable instrument shunt in which adjacent loops of the shunt resistance may be short-circuited.

1,008,329. ARC-LIGHT DIFFUSER. Albert H. Hawkes, New York, N. Y. Filed Jan. 28, 1911. About the arc is a light-tight box in the front of which are two shutters adjustable by means of a rod and gears operated from the rear.

1,008,340. SOUND-TRANSMITTER. Forrest E. Howes, Mattapan, Mass. Filed Mar. 10, 1909. An instrument for receiving and transmitting submarine signals comprises a vibrator diaphragm, a rubber layer secured against a face thereof, and electric signaling means operatively related to the diaphragm.

1,008,351. IGNITION PLUG. Benjamin F. Merritt, Canton, Mass. Filed Jan. 27, 1910. To the base of an inclosed induction coil is secured the spark plug proper.

1,008,370. AUTOMATIC FIRE-ALARM. Louis Robillot, Besancon, France. Filed Dec. 1, 1909. A rod of insulating material has helicoidal grooves cut in its surface, in each of which is a twisted two-strand cable that has its wires insulated by a layer of fusible material.

1,008,383. PROCESS FOR CONVERSION OF LOWER OXIDES OF NITROGEN TO HIGHER OXIDES OF NITROGEN. Fin Sparre, Wilmington, Del., assignor to E. I. du Pont de Nemours Powder Co., Wilmington, Del. Filed Sept. 7, 1907. Consists in passing an electric current through the oxide solution and through a diaphragm to an electrode in acidulated water. The current density on the latter electrode is low, while that on the anode is high.

1,008,391. METHOD OF CONTROLLING VAPOR ELECTRIC APPARATUS. Percy H. Thomas, East Orange, N. J., assignor to Cooper Hewitt Electric Co., New York, N. Y. Filed Feb. 9, 1904. Into a mercury-vapor lamp is introduced a gas serving to add red rays to the spectrum.

1,008,392. ELECTRIC SWITCH MECHANISM. George Steele Tiffany, Summit, N. J., assignor to Bankers Trust Co. Filed Oct. 28, 1907. A series of adjacent but independent contacts has a key for each set so arranged that when any key is operated it is locked and at the same time any previously operated key is released.

1,008,408. TELEPHONE-RINGING DEVICE. Harry N. Faris, Kansas City, Kans. Filed Mar. 22, 1909. A relay in series with a direct ringing device operates to change it into an inductive ringing device in response to an overload current delivered from the direct ringing device.

1,008,411. SAFETY DEVICE FOR ELECTRICALLY-HEATED IMPLEMENTS. Henry A. Hills, Grand Rapids, Mich. Filed Nov. 9, 1908. Includes an insulating terminal block upon which is secured a fuse.

1,008,423. ELECTRICAL CONDUCTOR. Henry K. McIntyre, New York, N. Y. Filed Mar. 27, 1906. The mated wires in a telephone cable are laid and transposed so as to reduce the static capacity, increase the inductance and eliminate cross-talk and inductive disturbances.

1,008,452. SELECTIVE SIGNALING SYSTEM. Vernon Durbin, Brookline, Mass., assignor to Holtzer-Cabot Electric Co., Brook-

line, Mass. Filed May 16, 1910. Current impulses of one direction through an electromagnet give a step-by-step motion to a rotary contact member, impulses of the opposite direction lock this contact-member, close a circuit between it and a co-operating contact and then separate the contacts.

1,008,453. CONTROL SYSTEM FOR ELECTRIC MOTORS. Arthur C. Eastwood and Harry F. Stratton, Cleveland, O., assignors to Electric Controller & Manufacturing Co., Cleveland, O. Filed Mar. 18, 1910. A controller for a reversible crane motor is arranged to place resistances in the armature and field circuits and in a shunt path around the armature when braking.

1,008,454. ELECTRIC CONTROLLER. Arthur C. Eastwood, Cleveland, O., assignor to Electric Controller & Manufacturing Co. Filed Sept. 24, 1910. Includes a magnetically-operated motor reverser, a resistance for controlling the motor, one or more switches for connecting the resistance to a source of supply, and a relay adapted to open the reverser-actuating circuit whenever any of the resistance-controlling switches closes.

1,008,482. CONSTANT-POTENTIAL ELECTRICAL SYSTEM. Dimmitt R. Lovejoy, Freneau, N. J. Filed May 7, 1910. Low-potential bells are operated from a high-potential source, by arranging four branch circuits in a Wheatstone network, of which two fixed resistances form the ratio arms determining the ratio of high to low potential, and the bells and a variable resistance form the other two arms. A pilot coil serves as a bridge and adjusts the resistance of the variable arm to maintain constant voltage on the bells.

1,008,484. ELECTROMAGNETIC INSTRUMENT. Walter K. Menns, Malden, Mass., assignor to Charles H. Pearson, Brookline, Mass. Filed Oct. 26, 1910. Comprises means for producing a magnetic field, a metal disk rotatably mounted in the field, and a thermostat for changing the relative location of the disk and field to compensate for changes of temperature.

1,008,485. SPARK PLUG. Charles A. Mezger, New York, N. Y. Filed Nov. 23, 1908. Has an insulation mass with an enlargement, packing gaskets surrounding the enlargement and a soft metal band surrounding the enlargement and inclosing the gaskets to hold them upon the insulation mass.

1,008,495. CONTROL SYSTEM FOR ELECTRIC MOTORS. James F. Schnabel, Cleveland, O., assignor to Electric Controller & Manufacturing Co., Cleveland, O. Filed Mar. 18, 1910. A controller for a reversible motor is arranged to govern the armature and field resistances and a brake winding.

1,008,496. PROTECTIVE DEVICE. Edmund O. Schweitzer and Nicholas J. Conrad, Chicago, Ill. Filed Apr. 12, 1910. A fuse within a long cylindrical casing is kept in tension by a spiral spring. A solid arc-intercepting diaphragm is arranged about the fuse.

1,008,506. TROLLEY-WHEEL SUPPORT. Charles A. Weisbacher and Joseph Staab, Pittsburgh, Pa. Filed Mar. 6, 1911. The trolley pole has a rotatable head and harp, the latter being flexibly held in normal position.

1,008,514. ELECTRIC SWITCH MECHANISM. Ralph W. Armstrong, New York, N. Y., assignor to Bankers Trust Co. Filed Oct. 26, 1907. A modification of No. 1,008,392.

1,008,521. ELECTRIC BLOCK-SIGNAL SYSTEM. Walter J. Bell, Los Angeles, Cal., assignor to Los Angeles Switch & Signal Co., Los Angeles, Cal. Filed Dec. 2, 1908. Alongside a trolley line is a sectionalized signal wire on which bears an auxiliary trolley. Electric lamp signals are controlled thereby.

1,008,525. SECONDARY BATTERY. Clyde J. Coleman, Rockaway, N. J. Filed Oct. 7, 1903. Comprises a number of vertically arranged plates having a number of active-material-carrying portions, insulating separators between the plates at the portions unprovided with active material, and insulating sealing means in contact with the plates about the margins thereof to complete the walls of such cells.

1,008,535. MOLDED CONDUCTOR. Emery G. Gilson, Schenectady, N. Y., assignor to General Electric Co. Filed Mar. 7, 1910. Consists of graphite associated with an iron-carbon compound.

1,008,543. TROLLEY. Frank H. Howard, Reading, Pa. Filed Apr. 8, 1911. Has an insulating axle, a pair of contact springs engaging the wheel and harp, and ball bearings at the ends of the axle.

1,008,549. ELECTRICAL MEASURING INSTRUMENT. Wilhelm Klinckert, Berlin, Germany, assignor to General Electric Co. Filed Apr. 8, 1908. Combined with polepieces mounted face to face, are non-magnetic space blocks and a magnetic core mounted between the polepieces, and a flat non-magnetic support for the core thinner than the space blocks and interlocked with them, to permit movement of the core in only one direction along its axis and to hold the core in position.

1,008,560. SUPPORT FOR THIRD RAILS. William B. Potter, Schenectady, N. Y., assignor to General Electric Co. Filed Oct. 21, 1905. An inverted third rail is supported between an insulated two-piece yoke mounted on an upstanding bracket.

1,008,561. DYNAMO-ELECTRIC MACHINE. Henry G. Reist, Schenectady, N. Y., assignor to General Electric Co. Filed May 19, 1909. The revolving field for a turbo-generator has a vertical shaft, a distributed field winding, and a cylindrical cover for its end turns.

1,008,562. ELECTRIC-MOTOR DRIVE. Robert H. Rogers, Schenectady, N. Y., assignor to General Electric Co. Continuation in part of application filed June 23, 1909. This application filed May 24, 1910. Combined with a number of direct-current motors, whose armatures are connected in parallel, and field windings in series, are means for varying the ampere-turns of each field without changing the total resistance thereof.

1,008,571. HOLDING AND RELEASING DEVICE FOR ELECTRICAL INSTRUMENTS. Herbert B. Taylor, Albany, N. Y., assignor to Federal Signal Co., Albany, N. Y. Filed Aug. 16, 1910. Includes an electromagnet whose armature actuates contact fingers. A screw controlled from the outside the case is adapted to bear against the armature and thus hold it in place.

1,008,572. PROCESS AND APPARATUS FOR INSULATING ELECTRIC CONDUITS. Charles Thibodeau, Cambridge, Mass., assignor to American Circular Loom Co., Boston, Mass. Filed Mar. 26, 1910. "Circular loom" is passed through the heated insulating compound and then through a long die that smoothes and scrapes off the surplus material.

1,008,577. HIGH-FREQUENCY ALTERNATOR. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Co. Filed Apr. 26, 1909. Comprises a stator carrying a pair of circumferentially extending laminated rings having opposite faces lying in adjacent radial planes, a winding carried in the faces, and a magnetic inductor adapted to be driven at high speed and having its periphery extending between the faces and formed with magnetic poles opposite the faces, the laminated rings being adjustable axially toward and away from the inductor.

1,008,580. ELECTRIC LOCOMOTIVE. Asa F. Batchelder, Schenectady, N. Y., assignor to General Electric Co. Filed Apr. 30, 1909. Is provided with two trucks each having two pairs of wheels, one motor mounted on each truck adjacent to and driving the pair of wheels nearest the middle of the locomotive, crank and connecting-rod driving connections between the wheels of each truck, and a leading connection between the trucks.

1,008,581. ELECTRIC-LOCOMOTIVE TRUCK. Asa F. Batchelder, Schenectady, N. Y., assignor to General Electric Co. Filed Nov. 13, 1909. Combined with two trucks adapted to be pivoted to the body and provided with two or more axles is a universal hinge connecting the adjacent ends of the trucks, and a thrust ring surrounding each axle and located inside of the journal box.

1,008,582. ELECTRIC LOCOMOTIVE. Asa F. Batchelder, Schenectady, N. Y., assignor to General Electric Co. Continuation of application filed Apr. 30, 1909. This application filed Nov. 7, 1910. Has a pair of driving wheels rigidly mounted on the axle, a frame in which the axle is journaled, a motor comprising a field structure mounted on the frame, an armature surrounding the axle, and means for yieldingly supporting the armature and driving the wheels therefrom comprising flexible rods extending through the armature and having their ends mounted in holes circularly arranged in the hubs of the wheels.

1,008,588. FILAMENT. William D. Coolidge, Schenectady, N. Y., assignor to General Electric Co. Filed Aug. 1, 1906. A tubular filament of tungsten having a slit along one side of the filament.

1,008,617. ELECTRIC METER. Gustave A. Scheeffer, Indianapolis, Ind., assignor to Columbia Meter Co., Indianapolis, Ind. Filed Jan. 14, 1910. A watthour meter has a damping disk of non-magnetic material in which are disposed iron sections equal in number to the armature coils. Adjoining one of the damping magnets is an adjustable magnetic screw directed toward the iron sections in the disk.

1,008,622. ELECTRIC HEATER. Elihu Thomson, Swampscott, Mass., assignor to General Electric Co. Filed Mar. 18, 1909. Comprises a high-speed motor having a rotary field and a stationary armature consisting of a short-circulated iron core with passages therethrough for the circulation of a fluid to be heated, a winding on the core for producing rotation of the field and thereby generating eddy currents to heat the core.

1,008,623. TRANSFORMER. Matthew O. Troy, Schenectady, N. Y., assignor to General Electric Co. Filed Feb. 2, 1911. An oil-insulated transformer has its terminal board submerged in the oil just above the windings. The core and board are arranged to permit free circulation of the oil.

1,008,625. MOTOR-CONTROL SYSTEM. Harold E. White, Schenectady, N. Y., assignor to General Electric Co. Filed June 19, 1909. Includes a master controller that governs a number of electromagnetic resistance switches and similar switches for dynamic braking.

1,008,628. BOILER CONSTRUCTION AND MEANS FOR MAKING THE SAME. Charles A. Brown, Hinsdale, Ill., assignor to Steam Power Devices Co., Chicago, Ill. Filed Aug. 1, 1910. The process of securing flues to the head of a boiler consists in placing a flue in position against the head, completing an electric circuit through the flue and head to weld the same together and exerting lateral pressure upon the flue.

1,008,629. FUSE ATTACHMENT FOR ELECTRIC LIGHTS. James Marion Cummings, Evansville, Ind., assignor of one-half to William Michael Hahn, Evansville, Ind. Filed Jan. 31, 1911. A portable hand lamp has a recess in the handle in which are arranged the line terminals, the lamp terminals and spring contact pieces with fuses secured to the inside of the cover for the recess.

1,008,634. TIME-CONTROLLED SWITCH. George W. Free, St. Louis, Mo. Filed Feb. 15, 1911. An alarm clock has its alarm-winding shaft engaged to the button of a rotary switch.

1,008,661. VENTILATED REFLECTOR. Julius Meyer, New York, N. Y., assignor to George Frink Spencer, Newark, N. J. Filed June 17, 1911. Has a pair of transparent partitions arranged to provide an intervening air space beneath the lamps, and a distributing box secured to the reflector body, thus providing a distributing air chamber in communication with the intervening air space.

1,008,701. RHEOSTAT. Lloyd Crump, Centralia, Mo. Filed Nov. 23, 1910. A receptacle of non-conducting material contains a fluid of high resistance. Two vertical parallel plates are set at a fixed distance apart and are adapted to be moved up or down in the liquid so that a greater or less portion is immersed. Brushes making contact with each electrode are connected to the external terminals of the rheostat.

1,008,728. VACUUM-TUBE ELECTRIC APPARATUS. Daniel McFarlan Moore, Newark, N. J., assignor to Moore Electrical Co., New York, N. Y. Filed Feb. 7, 1906. Has means for feeding gas into the tube at both ends and means for regulating the admission of the gas by an automatic valve action controlled through changes of the gas or vapor tension within the tube.

1,008,729. TENSION ADJUSTMENT FOR PULL-SWITCHES. Clarence D. Platt, Bridgeport, Conn. Filed Dec. 21, 1910. Embodies a spindle, a frictional adjusting device frictionally clamped to the spindle, a switch actuator operatively arranged upon the spindle, and a tension device intermediate the switch actuator and adjusting device.

1,008,756. SELF-SWITCHING ALARM. Bernhard Uhlmann, Garfield, N. J. Filed July 26, 1910. When the door is shut and the bolt in locked position the button of a push-button electric bell is allowed to be in normal or open position. The act of unlocking the door releases a drop arm and the button is pressed ringing the bell which is connected in an electric circuit.

1,008,762. METAL WORKING. Willis R. Whitney, Schenectady, N. Y., assignor to General Electric Co. Filed Mar. 23, 1910. A tungsten rod or wire is pointed by dipping an end into a fused nitrite. The patent also covers the corrosion of tungsten and chromium, by nitrite baths.

1,008,768. INTERRUPTING MECHANISM FOR ELECTRIC IGNITION SYSTEMS FOR INTERNAL-COMBUSTION ENGINES. Arnold Zähringer, Stuttgart, Germany, assignor to Firm of Robert Bosch, Stuttgart, Germany. Filed Aug. 10, 1910. Comprises a normally stationary interrupter cam, normally stationary contact terminals, and a rotatable member moving in the path of the cam and actuated thereby to separate the contact terminals periodically.

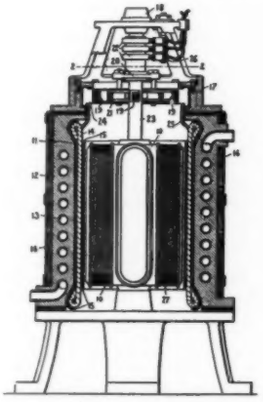
1,008,806 and 1,008,807. METALLIC FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS. Karl Farkas, New York, N. Y. Assignor of one-half to Guy V. Williams, New York, N. Y. Filed Aug. 9, 1909. Consists in imbedding shaped filaments of a highly refractory substance containing a glutinous organic binder in fine powder of oxid of the earthy metals, and heating the filaments under exclusion of the air to a high temperature to eliminate all the carbon and impurities.

1,008,808. METHOD OF DRAWING FINE WIRES OF REFRACTORY METALS. Karl Farkas, Glen Ridge, N. J. Filed June 23, 1911. The wire is heated electrically and drawn out in one direction. It is then given a second heat and drawn out in the opposite direction.

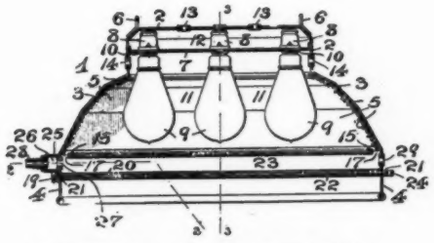
1,008,809. INCANDESCENT LAMP WITH DRAWN-METAL-WIRE FILAMENT. Karl Farkas, Glen Ridge, N. J. Filed June 23, 1911. Has a plurality of anchors supported by a glass stem of special construction, a drawn-wire filament composed of two portions being supported thereby. Each portion of the filament is connected by one end to the lead proper and by the other to the auxiliary lead.

1,008,811. STARTER AND REGULATOR FOR COMPOUND MOTORS. William H. Gaulke, Milwaukee, Wis., assignor to Independent Electric Manufacturing Co. Filed Feb. 6, 1911. Has two sets of contact arms and two sets of contact segments, each of which is connected to the successive sections of a resistance, the terminal end of one resistance being adapted for direct-connection with the armature of an electric motor, and the starting end of the other resistance being adapted for direct connection with the field. The two arms are operatively connected so that the armature resistance arm in returning to its starting point carries with it the field regulating arm, while the latter cannot be advanced without advancing the former.

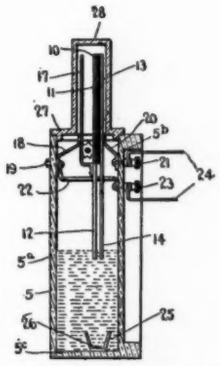
1,008,848. ELECTRIC PROGRAM CLOCK. Gottlieb Paul Milde, Selby, S. D. Filed Feb. 16, 1911. A member provided with a number of pins turns in unison with the minute hand of a clock. A pivoted contact member makes contact with the pins, this member being actuated by a ratchet wheel. A lever controlled by the turning member has a detent member engaging the ratchet wheel, and electric alarm-mechanism connected with the turning member and the ratchet wheel.



1,008,622.—ELECTRIC HEATER.



1,008,661.—VENTILATED REFLECTOR.



1,008,701.—RHEOSTAT.

1,008,852, 1,008,853, and 1,008,854. STORAGE-BATTERY ELECTRODE AND PROCESS OF MAKING IT. William Morrison, Des Moines, Ia. Filed Sept. 29, 1911. In the first patent particles of the active material are enmeshed in an absorbed skeleton, sponge or film of a desiccated solute of nitrocellulose. The second patent covers a body sponge or film of rubber. Material for the third consists of the solid reaction products of lead oxide, a chromium salt, and glycerine.

1,008,860. ELECTROLYTE FOR ALUMINUM CELLS. Frank W. Peek, Jr., Schenectady, N. Y., assignor to General Electric Co. Filed Feb. 5, 1909. The electrolyte contains a mixture of salts consisting essentially of a borate and a tartrate.

1,008,870. THERMOSTATIC SWITCH. Bert J. Smith, Modesto, Cal., assignor to Home Construction Co., Modesto, Cal. Filed Apr. 5, 1911. The square moving contact of the switch is supported by depending lugs so that sliding motion is permitted. The fixed contact is provided with a thread so that its distance from the movable contact in normal position may be regulated. The regulating contact is moved manually, a dial denoting the temperature at which the switch acts.

1,008,879. ELECTRIC CONNECTION-PLUG. Robeson B. Wolcott, East Cleveland, Ohio. Filed Feb. 19, 1910. One of the contact members has a spring finger extending outwardly beyond the end of the base, a sleeve adapted to be fitted onto the base being provided at its end with an insulated contact disk. The sleeve engages one of the contact members, and the insulated contact disk engages the end of the finger of the other contact member, when the sleeve is placed in normal position on the base.

1,008,880 and 1,008,881. TELEPHONE REPEATING CIRCUITS. Charles Adams-Randall, New York, N. Y., assignor to Randall Telephone Manufacturing Co., Augusta, Me. Filed Dec. 20, 1910. Combine independent main-line sending and receiving circuits, a relay and main-line relay circuit, a controller and a local

controller circuit governed by the main-line relay, and connections whereby the main-line sending circuit may be governed by the controller.

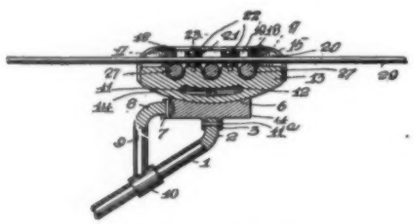
1,008,882. CIRCUITS FOR TELEPHONE REPEATING SYSTEMS. Charles Adams-Randall, New York, N. Y., assignor to Randall Telephone Manufacturing Co., Augusta, Me. Filed Jan. 3, 1911. The combination of independent main-line sending and receiving circuits, repeaters and local circuits associated with the main-line circuits, and an electro-magnetic device governing the circuits connected on one side through an impedance to a part of one of the circuits, and also connected on the other side to that part through an impedance.

1,008,900. SHADE-HOLDER. Gilbert W. Goodridge, Bridgeport, Conn., assignor to Bryant Electric Co., Bridgeport, Conn. Filed June 30, 1911. Tongues on the holder engage the member held by the supporting bead of the lamp socket. The parts are held by projections against any subsequent rotation with relation to each other.

1,008,922. SOLDERING TOOL. Hector P. MacLagan, Park Ridge, Ill., assignor of one-half to George M. Willis, Chicago, Ill. Filed June 20, 1910. The heat-conducting shell of an electric iron has at its working end two holes for the reception of a soldering tip. One of these holes is in a line parallel to the axis of the tool, the second being perpendicular to its axis. A set screw is provided so that the tip may be held firmly in either position.

1,008,933. INCANDESCENT LAMP. Samuel D. Washburn, Boston, Mass., assignor of one-half to In-Er Globe Lamp Co., Boston, Mass. Filed Jan. 11, 1908. The filament is bent in the form of two conical spirals so that a maximum distribution of light is obtained in a direction perpendicular to the bases of the spirals.

1,008,935. SPARK PLUG. William S. Witter, Julesburg, Colo. Filed Oct. 6, 1910. A solenoid coil is contained in the interior



1,008,968.—TROLLEY.

of the plug and is normally energized, keeping the sparking terminals apart. A movable terminal sliding in a hollow tube is provided with a flat end upon which the compressed gas in the cylinder pushes, causing the terminals to approach each other.

1,008,937. ELECTRIC LOCOMOTIVE. Asa F. Batchelder, Schenectady, N. Y., assignor to General Electric Co. Original application filed Apr. 30, 1909. Divided and this application filed Nov. 7, 1910. Relates to the construction of the trucks, and the method of supporting the body.

1,008,938. RAILWAY-SWITCH SIGNAL. Walter J. Bell, Los Angeles, Cal., assignor to Los Angeles Switch & Signal Co., Los Angeles, Cal. Original application filed Dec. 2, 1908. Divided and this application filed Feb. 27, 1911. The switch signal is operated by moving cars entering the section, or by movements of the switch.

1,008,960. FIRE-ALARM SYSTEM. William L. Denio, Rochester, N. Y. Filed Apr. 5, 1909. Comprises an alarm mechanism, an electrically operated device having terminals and controlling the operation of the mechanism, two separate conductors leading from the terminals of the device. A source of current is connected to one of the conductors and means are furnished for connecting a third conductor to both of the other conductors to complete an electric circuit through them.

1,008,968. TROLLEY. Harvey Jolly, Pittsburgh, Pa. Filed Jan. 10, 1911. The trolley harp carries, in place of a wheel, a number of horizontal rollers which turn in concave seats and bear upward against the trolley. Balls carried in the tops of flanges of the harp bear downward against the trolley holding it in place.

1,008,977. WAVE-DETECTOR. Thompson Harris Lyon, Renfrew, Pa. Filed Oct. 12, 1911. Cerusite is employed in the detector.

1,008,993. MACHINE FOR REELING RUBBER-COVERED ELECTRIC WIRE FOR VULCANIZATION. Thomas J. Seward, Bridgeport, Conn., assignor to Electric Cable Co., Bridgeport, Conn. Filed Dec. 28, 1910. A combination of devices for coiling the wire in reverse superimposed spiral coils, automatic means operating in harmony with the devices for continuously depositing powdered talc beneath the wire as fast as the latter is coiled.

1,008,998. VAPOR ELECTRIC LAMP. Percy H. Thomas, Montclair, N. J., assignor to Cooper Hewitt Electric Co., New York, N. Y. Original application filed Feb. 9, 1904. Divided and this application filed Nov. 5, 1904. One electrode is of a material capable of developing a condensable gas or vapor. A definite supply of non-condensable gas is contained in the tube, and means are provided for controlling the relative proportions of condensable and non-condensable gases.

1,009,008. ELECTRIC DENTAL HEATER. Wladislaw Asch and Dagobert Asch, Berlin, Germany. Filed Dec. 22, 1910. A pair of hollow tongs, suitable for hardening dental cement, is provided with electric heating coils.

1,009,013. ELECTRICAL APPARATUS FOR TRANSMITTING AND RECEIVING SIGNALS. Archibald Barr, Glasgow, Scotland, and William Stroud, Leeds, England. Filed Jan. 28, 1907. Includes a receiver having a set of motor devices each of which comprises an electromagnet having a pair of pole pieces and a complementary rotary unwound armature having radial arms in balanced arrangement. A transmitter commutates the current for energizing the magnets of the receiver.

1,009,015. ELECTRIC SIGNAL-ACTUATING MECHANISM. Walter J. Bell, Los Angeles, Cal., assignor to Los Angeles Switch & Signal Co., Los Angeles, Cal. Filed Feb. 13, 1911. The trolley wire is supported by an arm held by a coiled spring. When the trolley wheel passes under the device the arm is raised causing two points to come in contact, closing the signal circuit.

1,009,025. CONTROLLING VAPOR ELECTRIC DEVICES. Percy H. Thomas, Montclair, N. J., assignor to Cooper Hewitt Electric Co. Original application filed Feb. 9, 1904. Divided and this application filed Feb. 2, 1910. A vapor lamp contains a condensable gas or vapor and a non-condensable one. The non-condensable gas is caused to circulate through the condensable gas.

REISSUE.

13,312. CARTRIDGE FUSE. Albert F. Daum, Pittsburgh, Pa. Filed June 23, 1911. Original No. 961,716, dated June 14, 1910. A rechargeable fuse with threaded ends on which caps are screwed.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired November 20, 1911:

529,354. CONTACT DEVICE FOR OVERHEAD ELECTRIC RAILWAYS. Julius H. Blackwell, New York, N. Y.

529,363. ELECTRIC SWITCH OR CUT-OUT. John C. Cassidy, East Orange, N. J.

529,373. ELECTROMAGNETIC APPARATUS. Stephen D. Field, Stockbridge, Mass.

529,385. ELECTRIC FAN MOTOR. Frank X. Hofbauer, Newark, N. J.

529,406. UNDERGROUND ELECTRIC RAILWAY. Henry B. Nichols and Frederick H. Lincoln, Philadelphia, Pa.

529,411 and 529,413. MANUFACTURE OF ELECTRIC CONDUCTORS. John Robinson, Philadelphia, Pa.

529,412. INSULATED ELECTRIC CONDUCTOR. John Robinson, Philadelphia, Pa.

529,421. MULTIPLE-SWITCHBOARD SYSTEM. Charles E Scribner, Chicago, Ill.

529,429. ELECTRIC INCANDESCENT LAMP. Elihu Thomson, Swampscott, and Edwin W. Rice, Jr., Lynn, Mass.

529,433. ELECTRICAL MEASURING INSTRUMENT FOR SWITCHBOARDS. John Van Vleck, New York, N. Y.

529,434. ELECTRICAL MEASURING INSTRUMENT. Edward Weston, Newark, N. J.

529,435. ELECTRICAL MEASURING INSTRUMENT. Edward Weston, Newark, N. J.

529,451. COMBINATION GAS AND ELECTRIC LIGHT FIXTURE. Gustav A. Loeben, Philadelphia, Pa.

529,461. METHOD OF AND MEANS FOR SYNCHRONIZING ALTERNATING-CURRENT MOTORS OR GENERATORS. Henry N. Potter, Allegheny, Pa.

529,465. TELEPHONE SYSTEM. John I. Sabin, San Francisco, Cal.

529,488. ELECTRICIAN'S COMBINATION TOOL. Jacob M. Gile, Denver, Colo.

529,532. SWITCHING APPARATUS FOR INCANDESCENT ELECTRIC LAMPS. Charles E. Scribner, Chicago, Ill.

529,559. ELECTRIC CIRCUIT. Joseph W. Marsh, Pittsburg, Pa.

529,563. APPARATUS FOR GENERATING ELECTRICITY FOR LIGHTING RAILWAY CARS. Thomas A. Murray, Boston, Mass.

529,595. ELECTRIC SWITCH AND CUT-OUT. John C. Cassidy, East Orange, N. J.

529,650. CONTINUOUS-CURRENT DYNAMO-ELECTRIC MACHINE. Maurice Hutin and Maurice Leblanc, Paris, France.

529,654. ELECTRIC-LIGHT FIXTURE. John R. Konetshny, Brooklyn, N. Y.

529,666. ELECTRICAL RELEASING DEVICE FOR TARGET-TRAPS. Charles H. North, Cleveland, Ohio.

529,671. GEARLESS ELECTRIC LOCOMOTIVE. Charles J. Van Depeole, Lynn, Mass.